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Feeling the pulse? New high resolution U-Pb zircon geochronological constraints for the Northern Ireland sector of the North Atlantic Igneous Province

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The Northern Ireland sector of the North Atlantic Large Igneous Province (NIAP) is the biggest onshore exposure of the British and Irish Igneous Province. The Antrim Lava Group is composed mostly of flood basalt sequences (Lower and Upper Basalt formations) with associated acid-basic central complexes, dyke swarms, plugs and sill complexes (Cooper 2004; Cooper & Johnston 2004; Cooper et al. 2012) that display unconformable and cross cutting field relationships. This study has for the first time generated a self-consistent and representative chronology using high-precision CA-ID-TIMS U-Pb zircon isotopic dating across the range of lithologies to provide a fuller picture of how the region was operating during the Paleogene.

Results indicate that punctuated magmatism within the north of Ireland lasted at least c. 5.5 Myrs from c.61.5 to 56 Ma. The 61.5 Ma age comes from magmatic zircons from a paleosoil immediately below the Lower Basalt Formation (LBF), and is believed to represent the onset of magmatism in the region. This age is matched by that of the Killala-Erne Dyke Swarm (c.61.5 to c.61 Ma) which is now considered to have fed melt to LBF lava flows. Dates of c.61 Ma for the Tardree and c.60.7 Ma for Slieve Gullion igneous complexes are the youngest of this grouping which together spans about 1 Myrs and may represent the igneous activity associated with a single pulse of the Icelandic Plume.

Following the initial activity there was a break in magmatism-volcanism which led to the development of a thick weathering profile referred to as the Interbasaltic Formation. We then see the development of a regionally significant unconformity and deposition of the Coagh Conglomerate Member which includes clasts of Tardree Complex (or similar) rhyolite. This was followed by extrusion of the Causeway Tholeiite Member (CTM) and Upper Basalt Formation (UBF) across the region. A new age for the Portrush Sill Complex at c. 58.5 Ma provides a constraint on this episode of magmatism, however, it the combination of regional unconformity, outpouring of flood basalts and other magmatism that suggest a second pulse may be represented.

The Mourne Mountains Complex at c.56-56.5 Ma is not associated with flood basalts in Northern Ireland, however, in Scotland basalts of the Upper Skye Lava Formation are of similar age to the Mourne granites and together they might represent a third pulse of the plume in the region.

New U-Pb zircon geochronology has allowed for significant reinterpretation of the regional scale geology and stratigraphy of the Antrim Lava Group. Geochronological constraints define an early episode of igneous activity that is separated from the next by a prolonged period of weathering and the formation of a regionally significant unconformity. In summary three temporally discrete episodes of magmatism and tectonics with 1-2 Myr periodicity are observed that we believe resulted from a pulsing Icelandic Plume head.