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Lower Crustal xenoliths from the Iapetus Suture Zone in Ireland: isotopic evidence for juvenile crustal addition during the Caledonian Orogeny.

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The Iapetus Suture Zone (ISZ) marks the oblique collision of Avalonia with Laurentia during the end-Silurian Caledonian Orogeny. In view of oceanic subduction and arc magmatism along the margins of the Iapetus Ocean since the Ordovician, accretion of new crust would be expected within the ISZ. Because of younger cover, only about 15% of Irish surface geology astride the ISZ comprises potentially juvenile arc volcanic rocks or sediments derived from them. Moreover the deeper levels of the ISZ have not been exposed (only rocks of anchizone to lower greenschist facies occur at the surface).

A 3D-evaluation of the presence of juvenile crust is possible within the ISZ in Ireland due to the presence of several suites of deep crustal xenoliths, transported to the surface by post-Caledonian (Lower Carboniferous) alkali basalts and diatremes. The majority of the xenoliths are granulite-facies, migmatised metasediments (grt+sil+qtz+Kfs+rt±ilm±zrn±mnz). However felsic orthogneisses (qtz±Kfs±pl±bt±ilm±rt±zrn) and rare mafic granulites (grt+opx+qtz+pl+rt+bt) are also present. Hence the xenoliths afford an opportunity to sample this otherwise inaccessible deep geology, providing insight into the age, origin and evolution of the ISZ in Ireland.

U-Pb zircon geochronology of metasedimentary xenoliths demonstrates depositional ages no older than early Ordovician, the presence of Ordovician to Devonian igneous rocks and a lack of older Precambrian rocks. Laser-ablation Lu-Hf analyses of zircons from a Middle Devonian granitic orthogneiss indicate strongly positive εHf (395Ma) values (+12), while an early Devonian (c. 414 Ma) granitic orthogneiss, with Middle Ordovician inherited zircons, yields a whole-rock εNd (414 Ma) value of +4. These isotopic data together with the lack of evidence for Precambrian basement suggest that a substantial proportion of the entire crustal section is made up of accreted juvenile material.