

Understanding the provenance of ice-rafted debris (IRD) provides a means to link the behavior of individual ice sheets to proxy records of climate change. Here we present a new approach to determining IRD provenance using U-Pb geochronology of detrital minerals rutile and zircon. We characterize potential source regions from Scotland using detrital rutile from modern fluvial systems, and demonstrate that their unimodal rutile U-Pb ages reflect the timing of the last amphibolite facies metamorphism of the source rocks, imparting a distinctive source signature. Contrasts between these spectra and the bimodal IRD (ca. 470 Ma and ca. 1800–2000 Ma) rutile age signatures rule out Scotland as the sole source and suggest a Laurentian contribution; IRD zircon ages further support this view. U-Pb mineral dating has the potential to provide new insight on IRD provenance, because it allows linkage between IRD and individual source terranes based on their differing magmatic and tectonothermal histories. The occurrence of Laurentian-sourced IRD proximal to Scotland demonstrates widespread and rapid dispersal of debris across the subpolar North Atlantic during the Older Dryas cold oscillation, and implicates the Atlantic meridional overturning circulation as a control. This highlights the sensitivity of some IRD records to rapid climate change during the last deglaciation and supports the interpretation of Heinrich events as time-parallel marker horizons.