Re-Os Isotope Systematics of the British Tertiary Volcanic Province; Multiple Mantle Sources in the Proto-Iceland Plume

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New Re-Os isotopic trace element data are presented for primitive lavas from the British Tertiary Igneous Province (BTIP). These include magmas from the main plateau basalt sequences and younger MORB-type lavas. BTIP picrites have high Os contents ranging from 127-1681ppt, with the majority of the samples having greater than 400ppt Os. Re contents are lowest (<400ppt) in low melt-fraction melts with a garnet melting signature and higher (>600ppt) in high melt-fraction melts with no garnet melting signature. All magmas have radiogenic (>PUM; ~0.129) $^{187}Os/^{188}Os_{(i)}$ ratios with the exception of the MORB-like Preshal Mhor group which have $^{187}Os/^{188}Os_{(i)}$ ratios of 0.1216. The Skye Main Lava Series (SMLS) and Mull Plateau Group have similar $^{187}Os/^{188}Os_{(i)}$ ratios of 0.13349-0.14480 and 0.13134-0.15759 respectively. A newly identified high Ce/Yb SMLS group has distinctly higher $^{187}Os/^{188}Os_{(i)}$ ratios of 0.15705-0.16355. Systematic variations between Nd and Os isotopes indicate that many of the magmas have assimilated continental crust. Utilising new and published Os isotope data for the Lewisian crust allows 'back-stripping' of the crustal signature to derive information about the source composition of the BTIP. This modelling reveals that potentially four mantle sources were tapped during the generation of the BTIP. The main plateau lavas contain two sources, one with an Os isotope composition similar to PUM and ε_{Nd} of ~9 and another with $^{187}Os/^{188}Os$ ratios of 0.133-0.137 and ε_{Nd} of ~9. This source requires both a long term LREE depletion coupled with a radiogenic Os component; potentially recently recycled oceanic crust. Furthermore, the high Ce/Yb group were derived from a source with a $^{187}Os/^{188}Os$ ratio of 0.15 and ε_{Nd}>6. These lavas are also Fe-rich, and their source must be have been long-term LREE-depleted with a high Re/Os ratio. Modelling suggests these magmas contain a significant portion of old recycled oceanic crust. The Preshal Mhor magmas have Os and Nd isotope values consistent with derivation from DMM. The two sources for the SMLS are similar to those discovered in the modern day Iceland plume, indicating their longevity within the plume for 60 Myr.

Rise and Fall of the Last Glacial Maximum in southern mid-latitudes

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Reconstructing the global pattern of the Last Glacial Maximum (LGM) and its transition to the Holocene remains a challenging task facing paleoclimatologists. Records from southern mid-latitudes are particularly scarce. Attempting to improve the understanding of this topic we reconstruct extent and timing of mid-latitude continental paleoglaciations and their decay by mapping and dating of moraines. The Southern Alps of New Zealand are a privileged site for this approach: (i) the maritime climate regime of this small, glaciated mountain ridge in the middle of the ocean is robust lacking continental microclimate effects. (ii) evaluation of LGM glacial extension relative to current glaciers allow a quantification of the LGM snowline lowering, i.e. the underlying climate change. (iii) their mid-latitude position allows a direct crosscheck to other mid-latitude climate records evaluating potential regional and/or hemispheric climate pace maker areas. (iv) comparison to ice-core data from close by Antarctica might shed light on the climate linkage between Southern mid- and high latitudes.

The core of this study is the investigation of the well-preserved late Pleistocene moraines at Lake Pukaki at the dry East Side of the Southern Alps. We apply the method of Surface Exposure Dating (SED) and match these data with ^{14}C data from glacial deposits from the humid West Coast. Evidence available so far derived from the consistent SED and ^{14}C data indicate that glacial highstand during the LGM occurred some 28 kyrs ago and lasted some 10 kyrs before the LGM collapsed some 18 kyrs BP. Direct comparison of this data and cosmogenic dating from similar northern mid-latitudes indicates an inter-hemispherically synchronous collapse of the LGM. This results is not consistent with the broadly accepted theory of the North Atlantic region as the pace-maker and the Thermohaline Circulation as globalizer of abrupt climate changes, but rather suggests the tropics and the atmosphere as pace-maker and globalizer, respectively.

Similar dating is recently obtained from South America (Denton, 1999). The mountain glacier LGM in southern mid-latitudes appears to strikingly match periods of high dust transport to the interior of Antarctica, implying that Antarctic dust is produced by close-by mid-latitude glaciers.