U-series recoil ages of ice cores samples from Dome C, Antarctica

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Determining the absolute ages of ice within ice cores, ice sheets and glaciers remains non-trivial especially for the oldest ice (>100ka). While both insolation and Be-10 records have proven invaluable in creating ice-core timescales, neither can be used to evaluate the length of hiatuses, the extent of ice folding in ice cores, or the age of ice at the bottom sections of ice cores. U-series recoil from mineral aerosols (dust) into the ice matrix is one possible technique for determining the absolute age of ice, independent of any other parameters. We report here our progress in measuring ages using U-series. Concentrations of parent (^{238}U) and daughter (^{234}U) isotopes in the ice and dust fractions of the ice cores were measured by MC-ICPMS (Nu Instruments). Blanks were minimized (< 10pg) and sensitivity optimized (>1% efficiency) to achieve the precision and accuracy required for small sample sizes (< 1mg of dust). Additionally, we measured the 87Sr/86Sr and ^{143}Nd/^{144}Nd isotopic compositions by TIMS (Triton) to assess the source of initial uranium within the ice (prior to accumulation of daughters ejected from the dust) as well as the geographical source of the dust. Ages of samples from Dome C were calculated using an age equation that includes an ejection factor, the fraction of daughter products implanted into the ice relative to the total number produced, based on the surface to volume ratio of the dust grains. This parameter was measured by specific surface area determination using a specially designed nano-scale for this purpose. Eight 500-800g samples of ice from Dome C were chosen to test the viability of this technique on ice core samples. Remarkably, U concentrations and ^{234}U/^{238}U measurements combined with BET measurements results in measured ages overlapping with the published ages from the EDC3 timescale [1] for samples in the upper 3000m of the the ice core. Samples from the lower 40m yielded ^{234}U/^{238}U activity ratios that indicate ages older than 650 ka, possibly as old as 925 ka. This suggests that the oldest ice at Dome C may yet provide climate information prior to 800 ka.

[1] Parrenin *et al.* (2007) *Clim Past* **3**, 485-497.

Re-Os geochemistry of Fe-rich peridotites and pyroxenites from Horní Bory, Czech Republic

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Many recent studies have documented significant changes in the Re-Os systematics of mantle rocks caused by secondary processes including partial melting, melt percolation and weathering. It has been shown that melt percolation represents one of the most important process, during which Re and Os import or loss, and Os isotopic modification can occur depending on several parameters, including melt/rock ratios, sulfur saturation of the percolating melt, etc. In order to study such processes further, Re and Os concentrations, as well as Os isotopic compositions, were determined for a well-characterized suite of mantle peridotites and associated pyroxenites from Horní Bory, Bohemian Massif, Czech Republic. These mantle peridotites are of two types: Mg-Cr lherzolite and Fe-rich dunite/wehrlite associated with Fe-Ti pyroxenites. The Fe-rich suite formed by melt/rock reaction between lherzolite and a SiO_2-undersaturated basaltic melt characterized by a subduction-related signature. Associated pyroxenites likely represent crystallization products of these transient basaltic melts. The Mg-lherzolite samples have variable Re and Os concentrations of 130-510 ppt and 3.7-7.5 ppb, respectively, and ^{187}Os/^{188}Os ratios of 0.122-0.123. Therefore, the Re and Os contents are similar to ~2x higher than Primitive Upper Mantle (PUM) estimates. The Os isotopic compositions are all lower than PUM. In contrast, the Fe-rich suite and associated pyroxenites are highly enriched in Re (0.95-2.2 ppb), depleted in Os (0.1-1.8 ppb), and show very heterogeneous and highly radiogenic ^{187}Os/^{188}Os of 0.172-0.681 compared to PUM. The very high Re contents coupled with radiogenic Os isotopic compositions of Fe-rich dunite/wehrlites and pyroxenites imply significant Re and radiogenic Os import from basaltic melts during subduction-related mantle refertilization. For these rocks, such process evidently resulted in removal of primary Os from the source rock. On the other hand, the higher and coupled Re-Os concentrations in one sample of Mg-lherzolite suggest that this suite was also modified during melt infiltration, but with minimal effect on Os contents and ^{187}Os/^{188}Os, presumably as a result of lower melt/rock ratios.