U-series recoil ages of ice core 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 or the extent of ice folding in ice cores. Traditional radiometric techniques have been difficult to implement because of low concentrations. In principle, U-series recoil chronometry, wherein daughter products accumulate in the ice from recoil out of dust, should be applicable to dating ice (e.g. [1, 2]). The primary difficulty in applying this technique is the low concentration of dust in polar ice samples, and therefore, of the recoil daughter products in the ice. Previous work on dust in ice cores indicates < 1mg dust per kilogram of ice from the ice cores of Greenland and Antarctica. Therefore, these measurements require low blanks, quantitative recovery of the parent and daughter isotopes, high sensitivity and precise, accurate measurements. We have implemented ultra-clean techniques for decontaminating, melting, and analyzing ice core samples. Concentrations of parent (^{238}U, ^{235}U, ^{232}Th) and daughter (^{234}U, ^{230}Th, ^{226}Ra, ^{231}Pa) isotopes in the ice and dust fractions of the ice cores are measured by isotope dilution on a Nu Instruments MC-ICPMS Additionally, we measure the $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ to assess the source of initial U within the ice. Total procedural blanks are < 10pg U and Th, < 0.2fg Ra and Pa, < 50pg Sr and < 10pg Nd. Two 500g samples of sequential age (MIS6) ice from Dome C were chosen to test the viability of this technique on ice core samples. Mean radii and size distribution of the dust particles have been previously measured by Coulter Counter on a small aliquot of each segment [3]. U concentrations and $^{234}U/^{238}U$ measurements combined with grain size and estimated dust surface roughness results in measured ages of 164 ± 10 and 162 ± 10 ka, overlapping with the published ages, 162 ka and 163 ka, from the EDC3 timescale [4]. This suggests that U-series recoil ages may be a valuable new tool for ice chronology.

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PGE geochemistry of strongly differentiated intrusions from the Bohemian Massif, Czech Republic

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Platinum-group elements (PGE) represent a powerful tool for study of upper mantle differentiation and magma fractionation mainly due to their high sulfide/silicate distribution coefficients. In spite of numerous PGE data from sulfur-saturated systems and upper mantle rocks, there is only a limited dataset from basaltic rocks and their plutonic equivalents (e.g., gabbroes, diorites). Such data are necessary to explain behavior of the PGE during sulfur-undersaturated magma differentiation.

We analyzed 42 samples from three differentiated intrusions (Kdyně, Drahotín, Mutěnín) located in Western Bohemia for their PGE concentrations. Kdyně and Drahotín intrusions are formed by gabbroes, gabronorites and diorites (some of them are Fe-Ti-rich) and show layered structure. In contrast, Mutěnín intrusion has concentric shape comprised of Fe-Ti-rich alkaline diorites-syenites. All rocks have very low PGE contents ($\sum$ PGE < 8 ppb) and show I-PGE (Ir, Ru) mantle-normalized depleted PGE patterns (Pd/Ir_N = 3.9-58.7) with positive Pt anomalies. This is most probably due to low sulfur contents of these intrusions. If we exclude samples with very high Pt contents, gabbro-diorite rocks from Kdyně and Drahotín have lower average Pt/Pd ratios (1.9-2.1) comparing to Mutěnín intrusion (3.4), but similar very high Cu/Pd ratios (21,000-278,000). PGE do not correlate between each other, but general correlation between Ir and Pt exists in Mutěnín and Drahotín intrusions.

All above described features point to most probably sulfur-undersaturated conditions during which magma was emplaced and fractionated (i.e., sulfides retain in the source) and/or early sulfide fractionation. This is also supported by the negative correlation between Pt/Pt* and Pd/Ir. It can be seen from our data that during fractionation of sulfur-undersaturated magma, P-PGE (Pd, Pt) behave incompatibly, whereas I-PGE (Ir, Ru) behave compatibly.