U-series comminution ages: Depositional age and transport times for non-marine sediments

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An important timescale in sedimentary cycling is the elapsed time between formation and deposition of sediment grains. This timescale is critical for assessing sediment residence and transport times, and may equate with depositional age in some environments. U-series isotopes may provide a way to determine this timescale, referred to as the "comminution age" (DePaolo *et al*. 2006). The approach is based on the decrease in the [^{234}U/^{238}U] activity ratio resulting from alpha-recoil loss of the ^{234}U isotope from a grain once it is reduced below a threshold grain size.

We have investigated the relationships between the [^{234}U/^{238}U] activity ratio and sediment characteristics for a core from the Kings River alluvial fan to determine if this method can be applied to non-marine deposits. This fan is a large Pleistocene-age feature whose deposits originate from a glacially-influenced drainage basin on the western side of the Sierra Nevada, California (Weissmann *et al*. 2002). We confirm a decreasing [^{234}U/^{238}U] ratio with decreasing grain size and with increasing sediment age, consistent with a model where recoil loss of ^{234}U is the dominant process controlling the [^{234}U/^{238}U] ratio in the detrital fraction. Various leaching procedures to remove non-detrital phases were investigated; the U isotope signature of the residue can be sensitive to this leaching. Parallel studies of sediments from Owens Lake, CA (USGS core OL-92) do not show a strong correlation between grain size and [^{234}U/^{238}U] activity ratio, likely due to relatively high concentrations of U in non-detrital components that are not easily removed by leaching.

These initial results indicate that the [^{234}U/^{238}U] comminution age method may indeed be a valuable tool for understanding sedimentary timescales, but methods for sampling and treating the sediments need refinement. Combining this approach with Nd and Sr isotopes to assess provenance, studies of sediment composition and physical characteristics, and modeling of recoil effects will also be discussed.

References

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Integrated air quality assessment – Accumulation, transport, and source recognition of PAH

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In a multidisciplinary approach atmospheric quality in the Greater Cologne Area (GCA) was studied using pine needles as bioreceptors. Here we report accumulation behaviour, transport fractionation, source allocation and the spatial distribution of polycyclic aromatic hydrocarbons (PAH). The organic pollutant load is compared and interpreted in concert with major and trace elements, δ^{13}C and δ^{15}N isotopes, and environmental magnetic data.

The GCA comprises a complex mixture of various PAH emission sources, mainly lignite fueled power plants, highly trafficked regions, domestic heating and large industrial complexes along the Rhine Valley. Our previous studies demonstrated a systematic accumulation of PAH in/on pine needles and a statistically significant variability in the PAH concentrations between different sampling locations. In this study we focus on the discussion of PAH distribution maps based on data from 71 locations that are equally distributed on 3000 km² in the GCA.

In addition to the parent PAH listed in the EPA priority list we analyzed the dispersal of alkylated 3/4-ring PAH, increasing the number of PAH to >50 and thus improving their source diagnostic potential. In the GCA the dominant emitters of PAH are lignite-fueled power plants, followed by traffic in urban regions, and petrochemical plants along the river Rhine. Power plant emissions are characterized by elevated concentrations of phenanthrene, dibenzothiophene and benzo[a]pyrene and reduced amounts of methyl- and dimethylphenanthrenes (MP, DMP). Traffic derived combustion PAH are recognized by high abundances of anthracene, 9-MP, 1,7-DMP and cyclopenta[def]-phenanthrene (CPP). Emissions of thioaromatics from vehicular engines are small due to the recent introduction of low-sulfur diesel. Release of uncombusted PAH from refineries and petrochemical industry is indicated by a high level of alkylated PAH and specific alkylation patterns. The ratio of 2/1-MP or 1,3+2,10+3,9+3,10-DMP/CPP are particularly high in refinery areas. Wood combustion is recognized by specific distribution patterns of 1,7-DMP (gymnosperms), 1,8-DMP (angiosperms) and retene.

Transportation distance and fractionation are assessed by investigating the relative proportions of 4-, 5-, and 6-ring PAH. Concentrations of particle phase bound PAH correlate well with those of magnetic combustion particles and are dominated by short transportation distance. Traffic indicator PAH show a perfect spatial distribution match to trace element indicators like Sb, Fe and Cu. Multiproxy air quality analyses allows for very reliable and independent source allocation especially in areas with multiple emission sources.