Improving the distinction of cosmogenic ^{21}Ne from other neon components in quartz

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The accuracy of surface exposure dating based on cosmogenic ^{21}Ne depends critically on our ability to discriminate against non-cosmogenic Ne components, such as nucleogenic Ne produced by (α,n) reactions on ^{18}O and ^{19}F or non-atmospheric trapped Ne. In quartz, the mineral most widely used for cosmogenic nuclides studies today, the abundance and significance of such components is obviously related to the type of host rock, its age and its metamorphic history. For example, quartz from granitic rocks may carry a lot of nucleogenic Ne produced in U/Th-rich inclusions or by implantation of α particles into the quartz. On the other hand, vein quartz may contain a lot of trapped gases in fluid inclusions, with isotopic compositions differing from those in the atmosphere. Recent work in the Potsdam lab has provided some new insights applying to ^{21}Ne surface exposure dating.

In quartz from granitic rocks exposed by giant landslides in the Puna region (Argentina), a considerable reduction of the nucleogenic Ne contribution was achieved by adopting the integral quartz separation procedure of Kohl and Nishiizumi (1992) and reducing the average grain size to <50µm, instead of applying a simple HCl treatment followed by hand-picking. A test is currently underway to investigate whether a better purity of quartz resulting from HF/HNO_3 etching or the opening of fluid inclusions is the primary reason for the reduced abundance of nucleogenic Ne. In the case of vein quartz containing noble gases derived from crustal fluids, grinding to small grain size is an obvious method to get rid of a major part of these trapped components. The distinction of cosmogenic Ne from crustal Ne is thus facilitated by larger relative ^{21}Ne excesses. Adsorption of atmosphere-derived Ne on fresh grain surfaces, as indicated for the heavier noble gases Ar and Xe, is insignificant.

According to earlier studies, cosmogenic Ne in quartz degasses predominantly below a temperature of 600°C. Our data confirm a release at low temperatures, but indicate some variation among samples suggesting that 800°C is a safer general limit. The variations are obviously related to grain size, as the release patterns of samples crushed to <50µm are shifted towards lower temperatures. In one case, ~95% of cosmogenic ^{21}Ne was degassed below 400°C, raising the question whether such fine-grained quartz my lose part of its cosmogenic Ne already during grinding or by pre-heating at 100°C in the sample storage section of the extraction line. Such a possibility, which would require precautions not to crush quartz too finely, is currently investigated.

Kohl C.P. and Nishiizumi K. (1992) *Geochim. Cosmochim. Acta* **56**, 3583-3587.

Isotopic compositions and concentrations of estuarine thallium

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A recent study has revealed significant fractionations of Tl stable isotope compositions in the marine environment (Rehkämper et al., 2002). ε^{205}Tl varies between –6 for seawater and +15 for ferromanganese crusts (where $\varepsilon^{205}\mathrm{Tl} = 10^4 * ({}^{205}\mathrm{Tl}/{}^{203}\mathrm{Tl}_{\mathrm{sample}} - {}^{205}\mathrm{Tl}/{}^{203}\mathrm{Tl}_{\mathrm{NIST\ 997}}) / {}^{205}\mathrm{Tl}/{}^{203}\mathrm{Tl}_{\mathrm{NIST\ 997}})$. Therefore, it appears that Tl isotopic variations, combined with concentration data, can be used for a detailed characterisation of the distribution and behaviour of Tl in the oceans.

In this study, we analysed Tl in water samples covering the entire salinity gradient of the Amazon estuary. All measurements were conducted by MC-ICPMS; concentrations were determined using isotope-dilution. The analytical reproducibility for in-house river and seawater standards was better than ±1 ε^{205}Tl (2sd) for the isotopic compositions and better than 3% (2sd) for the concentrations.

The results demonstrate that Tl does not behave conservatively in the Amazon estuary. The riverine endmember has a significantly lower Tl concentration (~4 ppt) than seawater (~11 ppt). The highest Tl abundances (~18 ppt) are observed at mid-salinities (15‰), after which they decline rapidly to seawater values at 25‰ salinity. In contrast, the Tl isotope compositions are observed to be almost constant at $\varepsilon^{205}\mathrm{Tl} \approx -3.5$. Only the seawater endmember is slightly lighter at $\varepsilon^{205}\mathrm{Tl} \approx -4.5$. The negative ε^{205}Tl of the river water probably reflects fractionation during weathering because igneous rocks in general have $\varepsilon^{205}\mathrm{Tl} > -3$. Weathering processes are thus inferred to generate dissolved Tl with low ε^{205}Tl values and a residue with higher ε^{205}Tl.

The increase of the Tl concentrations at intermediate salinities can be explained by the release of Tl from particulate matter. It is unlikely that this Tl comes from detrital particles. If such particles indeed have high ε^{205}Tl, the release of Tl must be accompanied by isotope fractionation. Thus, only a small fraction of the Tl could be released without changing the isotope composition of the dissolved Tl. Alternatively, there may be significant Tl that is not held within detrital phases and is in isotopic equilibrium with the estuarine water. If the Tl isotopic composition of these particles is different relative to the dissolved Tl, release of Tl by desorption must be accompanied by isotope fractionation. Mass balance then requires that only a small fraction of the Tl is released. The scenario becomes much simpler if the readily released particulate Tl and the dissolved Tl have the same isotope composition. In this case, there is no restriction on the extent of Tl-release from particulates.