Use of ^{7}Be as a Tracer of Sediment Erosion, Transport and Fate

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Relatively short half-life fallout radionuclides, such as ^{7}Be (53.3 days), ^{137}Cs (30.1 yr) and ^{210}Pb(22.3 yr) can be used as tracers for quantifying the source, transport and fate of sediment that complement the use of other tools for examining these processes over much longer time spans.

Fallout radionuclides are delivered to the landsurface and sorb to surface particles. The radionuclides develop distinct distributions in the soil column depending upon fallout history, half-life, and landuse practice. Consequently different depths of erosion produce sediment with unique radionuclide signatures. Those signatures can be used to develop multiple mass balances to deduce the depth and areal extent of processes eroding sediment.

Although both ^{7}Be and $^{210}Pb_{xs}$ are strongly sorbed to fine particulates upon delivery to the surface, and, in principle, could be used to date suspended sediments, they fail as suitable dating tools because their delivery to the surface is highly variable and unpredictable in time. In addition, $^{210}Pb_{xs}$ has a half-life too long to enable its use for dating younger suspended sediment. However, because both ^{7}Be and $^{210}Pb_{xs}$ are washed from the atmosphere and delivered together to the surface, the $^{7}Be/^{210}Pb_{xs}$ ratio would be expected to be much less variable than either isotope individually. This has been previously observed. Moreover, because of the short half-life of ^{7}Be, the value of the ratio in suspended sediments would be expected to reflect the age of the sediments. Thus a $^{7}Be/^{210}Pb_{xs}$ chronometer can be developed for fluvial suspended sediments.

The activity of radionuclides along the transport path also permits estimation of particle transport distances. Since the half-life of ^{7}Be is very short it can allow the recognition of sediment recently eroded from the landscape and in transit through the channel network. Various models (exponential and gaussian) suggest fine sediment is transported distances up to tens of kilometers during single steps of transport.

Helium trapped in old porcelain: On the historical variation of the He isotopic ratio in air

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Purpose of our experiments

It is suggested that there is a historical variation of He isotopic ratios in air caused by human activity (Sano et al., 1989). However, Lupton and Graham (1991) denied it from their observations. Recently, Person-Wickmann et al. (2001) reported small excess of ^{3}He in historical slags processed in 1500AD. Thus it is still in debate whether there is a temporal variation of atmospheric $^{3}He/^{4}He$ ratio or not. It is very important if human industrial activity like burning of fossil fuels gives effect on the variation of He isotopes in air.

We have examined the He isotopic ratios in old Chinese porcelain on the thought that the old atmosphere could be preserved in voids in old porcelain, in order to investigate the historical variation of the He isotopic composition of the terrestrial air.

Samples and results

We used two pieces of old porcelain samples. The first sample (No. 9) was made in 1700AD and the second one (No. 2) was in 1400AD in China. We have obtained He isotopic ratios by crushing and total fusion for No. 2 and only by fusion for No. 9. A slightly high $^{3}He/^{4}He$ ratio (R/Ra = 1.07±0.03) was obtained from the crushing experiment for No. 2, but the total fusion data were not distinguished from the present air value within their error values for both No. 2 and No. 9.

The elemental abundances and Ar isotopic ratios were also measured for No. 9, which shows the fractionation enriched in heavy isotopes. Thus there is a fractionation effect at the trapping of air into porcelain. This fractionation is an opposite trend (enriched in heavy isotopes and gives lower $^{3}He/^{4}He$ ratio) to detect the high $^{3}He/^{4}He$ ratio in the past atmosphere. Thus obtained results may indicate that the $^{3}He/^{4}He$ ratios in the old porcelain are higher than the present air value.

References

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