Depleted mantle evolution and how it is recorded in zircon

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The compositional evolution of depleted mantle was controlled by rates of continental crust formation, recycling and by mixing with undepleted mantle. One approach to understand how those processes interplayed during the Earth history is to analyze variations in whole rock isotopic composition through time. Depleted mantle evolution models tend to be based on mafic and ultramafic rocks, as they seem to record unmodified isotopic composition of the mantle. The drawback of using whole-rock data is the possibility of resetting of isotopic systems by later alteration processes. In contrast, zircons are much more abundant and resetting of Hf isotope systematics is rare.

We review recent analyses of Hf isotopes in near concordant zircons and compare them with whole-rock analyses of mafic and ultramafic rocks to constrain the evolution of the depleted mantle. Zircons generally have lower maximum initial εHf than whole rocks for zircons older than 2.0 Ga and they extend to similar values for zircons 2.0 Ga or younger. Our model is *not* based on maximum initial εHf in zircon but on correlations between mixing arrays, age peaks and crustal evolution arrays. Zircon seems to preserve information on depleted mantle composition despite it crystallizing mainly from felsic magmas. The depleted mantle evolution curve based on zircons appears to be linear, at least between 4.0 and 1.0 Ga. Increasing maximum εHf in zircons from 4.0 Ga to 1.0 Ga implies that the mantle evolved smoothly towards increasingly superchondritic εHf values and there is no evidence for a decrease or an increase in εHf, and therefore, enhanced crustal recycling or formation from the depleted mantle over this period.

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Using artificial radionuclides as tracer of natural process emissions

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From measures done by atmospheric sampling stations of the French OPERA network (Permanent Observatory of the Radioactivity), we study the evolution of natural and artificial radionuclides in aerosols.

Among the artificial ones, ^{137}Cs, with a half-life of 30.2 year, is still finding at trace level in all compartments of the biosphere at the Eurasian scale, due to atmospheric weapons tests and Chernobyl fallout. So, mechanisms able to produce a great particles flux from biosphere element can lead to a significant ^{137}Cs flux. As wind resuspension and particles emission from biomass burning are the main processes that explain the persistence of this artificial radionuclide in the low atmospheric layers [1, 2], we use ^{137}Cs airborne activity level as a tracer of natural process emissions with the aim of distinguishing anthropogenic from naturally induced pollution events.

For instance, dust storms in the Saharan desert or large scale biomass burning events in Eurasian boreal forests can lead to daily PM_{10} levels which exceed 50µg.m^{-3} required by European Directive and a significant increase of ^{137}Cs. This increase of ^{137}Cs linked to natural radionuclides increases as ^{40}K, allow to conclude to a natural pollution episode. This was the case at the end of the 2002 summer with wildfires in Eastern Europe and high daily PM_{10} levels on the major part of Europe [3] or in February 2004 with a Saharan dust outbreak in southern France.

On the other hand, pollution events due to transport, industrial emissions or secondary aerosol formation do not involve a ^{137}Cs increase and can be amplified by stability atmospheric conditions. Then, the evolution of Radon progeny (natural radioactivity), which gives indication on dispersion conditions, enable to estimate the meteorological contribution in enhanced concentrations.

Thus, from time series for several radionuclides in the atmosphere, we can determine anthropogenic emissions part and natural environmental influence on air quality.

[1] Karlsson *et al*. (2008) *Atm. Env.* **42**, 7034-7042. [2] Wotawa *et al*. (2006) *Geophys. Res. Lett.* **33**, L12806 [3] Piga *et al*. (2008) *EAC*, T06A184P.