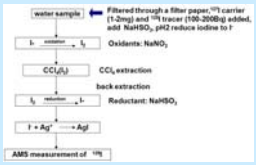
Analysis of ^{129}I and Pu Isotopes and Its Application

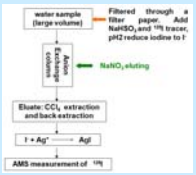
黄土与第四纪地质国家重点实验室

Analytical methods for determination of ^{129}I in different types of environmental samples

A carrier free method by coprecipitation of AgI-AgCl for separation of iodine and its species in naturally terrestrial samples with low iodine content were developed for the first time in IEECAS, solved the problem of accurate determination of ultra-low level ^{129}I in the pre-nuclear terrestrial samples. The analytical methods was proved to be reliable by analysis of certified materials.



Solvent extraction for separation of inorganic iodine in water sample



Anion exchange chromatography for separation of inorganic iodine from large volume of water sample

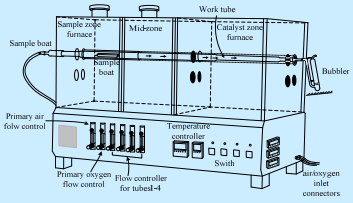
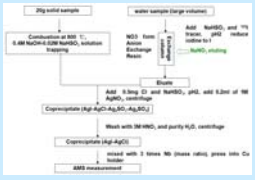


Diagram of the modified Catalytic Pyrolyser-4 Trio^{TM} furnace



Coprecipitation method for separation of carrier free iodine

The tube-furnace with 4 work tubes can treat 4 samples simultaneously. Cross-contamination between samples prepared in same work tube is proved be negligible. Up to 20g soil sample can be treated and 4-5 h is needed for one batch of samples. The analytical capability of 8-12 samples one day can be achieved.

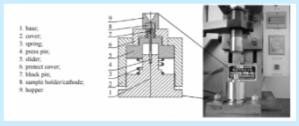


Diagram of devices for preparation of AMS target by pressing the mixed sample and matrix to target holder (designed by Wennian Zhao, et al. China Patent)(刘起等，2013)

Analytical methods for ^{129}I developed in IEECAS

Combustion → soil，sediment，plant (maximum 12 samples per day)

(Luo et al., 2011)

carrier free separation and ^{129}I –AMS measurement method (coprecipitation AgI-AgCl) → ultra-low level ^{129}I in low iodine content samples (reported first time)

(Hou et al., 2010)(Zhang et al., 2013;刘起等, 2013)

Sequential extraction method for ^{129}I speciation → ultra-low level ^{129}I speciation (dating research)

(Luo et al., 2013)

coprecipitation for ^{129}I speciation-Carrier free → directly used for concentration analysis of ^{129}I as well as its speciation in seawater, or samples with similar matrix

(Luo et al.,2013; Shan Xing, unpublished,2014)

→ **soil，sediment，plant, seawater, rain, river, brine et.al.**

(Fan et al., 2013)
(Zhang et al., 2013)

Analytical results of ^{129}I in certified reference materials

Standard Material	measured ^{129}I concentration	Certified ^{129}I value
IAEA-375	0.00143 ±0.00013Bq/kg	0.00170 ±0.0004Bq/kg
NIST Seaweed 4359	0.01420 ±0.00119Bq/kg	0.01490 ±0.0002Bq/kg
IAEA-418	(2.33±0.11) ×10^8at./L	(2.44±0.27) ×10^8at./L

Nuclear environment safety investigation using ^{129}I

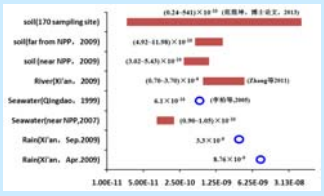
With the rapid development of the nuclear industry in China, nuclear environmental safety has attracted significant attention, volatile fission product ^{129}I and high toxic Pu isotopes are ideal tracer for this purpose.

1)^{129}I : reconstruct ^{131}I released from nuclear activity and nuclear safety assessment.

2)^{129}I and Pu isotope: evaluate the impact of previous nuclear activities.

^{129}I levels in environmental samples collected surrounding a Chinese nuclear power plant, agree well with the reported values in samples from background area in China , showing that no significant amount of ^{129}I was released from this NPP, and reflecting a safe nuclear environment in terms of ^{129}I level. ^{129}I distribution investigation in large area of China has been carried out for the first time, providing the first batch of data on ^{129}I background database of China.

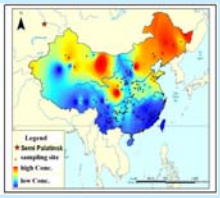
Comparison of ^{129}I levels in seawater, soil samples collected surrounding a NPP(Nuclear Power Plant) with the reported values of other environmental samples in China



(Zhou et al.，2013)

^{129}I Concentration in Chinese surface soils

^{129}I :(0.307-144)×10^6 at/g

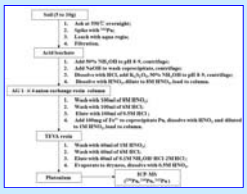


(Fan，Ph.D thesis，2013)
(Hou et al., unpublished)

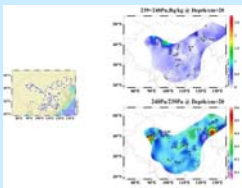
Investigation of Plutonium isotopes in Chinese soil

Analytical method for plutonium(Pu) isotopes in Chinese soil has been developed. About 200 surface and depth profile samples of soil collected over all China has been analyzed to investigate the sources and the environmental migration behavior of Pu. This project provides the first batch of data for Pu background database of China , which are critical for evaluating the environmental impact of early Chinese nuclear activities in 20st century. This is the largest range Pu isotope analysis in China at present.

$^{239+240}Pu$,^{240}Pu/^{239}Pu in Chinese surface soils



Improved analytical procedure for ^{239}Pu, ^{240}Pu in Chinese soil



（Shan Xing, Xiaolin Hou et.al., unpublished，2014）

Preliminary results：
1. Pu Conc.distribution: latitudinal differences;
2. atmospheric deposition is the main source of Pu in Chinese soil;
3. abnormal values suggesting there are other sources, need further studies;

Reference

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