High Precision Cadmium Isotopic Measurements by MC ICP-MS

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INTRODUCTION

In the 70'S, some studies of cadmium isotopic composition have been made by Rosman et al. principally in extra-terrestrial material. More recently, lunar soils were study by Sands et al. by TIMS and Wombacher et al. have studied Cd isotopic composition in chondritic meteorites by MC-ICP-MS and have a precision better than the other. The main explanation of the Cd isotopes fractionation is the evaporation / condensation processes. We want to see if an urban waste incinerator provide a Cd isotopic composition variation. We have studied different residues like fly ashes (CEL), filtration cakes (Gat.) (Figure 1). The main aim of these analyses is to survey the environmental impact of the incinerator.

METHODS

For isotopic analyses, cadmium has been separated from the matrix using anionic resin AGMP1 with total recovery of 100 percent (Figure 2). This chemistry from Mason et al. permits to removed major isobaric interference Sn, Pd and In. Isotopic ratios were measured with a Micromass Isoprobe MC-ICP-MS using the sample standard bracketing method, the instrumental operating system are in table 1. Results are reported in part per 10000 (ε) per amu relative to the isotopic composition of an in-house Cd standard solution. The reproducibility obtained on standards run during the series of measurements is less +/- 0.05 ε (2 σ, n=48). However, the uncertainty obtained on single samples (n=4) is higher and may reach +/- 0.2 ε.

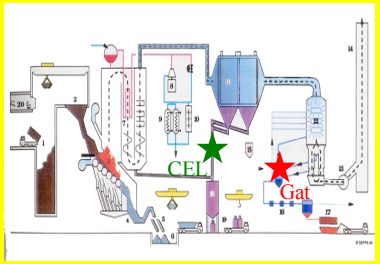

Figure 1

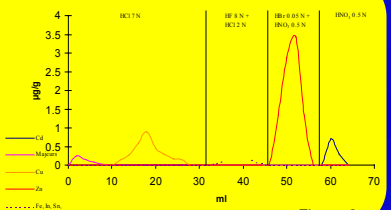

Figure 2

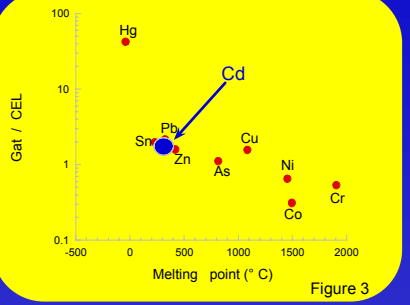

Figure 3

Instrumental operating conditions and signal measurement parameters

RF Power	1450 W
Plama gas flow rate	13.32 L/min
Interfaces cones	nickel
Acceleration voltage	c.a -6 kV
Ion Lens setting	Optimized for max.intensity
Instrument resolution	~ 300
Mass analyser pressure	5.17*10-8
Detector	9 Faraday collectors
Nebuliser	Teflon
Sample uptake rate	100 µL/min
Typical Cd sensitivity	7V/ppm
Sampling time	2 repetitions of 20 * 10 sec

Table 1

OBSERVATIONS

We have done a ratio of the concentration between the fly ash (CEL) ("residue" phase) and the filtration cake (Gat.) ("volatile" phase) and we have reported in function of the melting point of each element (figure 3). This give an idea of the volatility of each element and we recognise the refractory and volatile elements like Hg. Cd seems to have a volatile comportment within the incinerator.

RESULTS

Cadmium isotopic composition in samples analysed show a total variation of about 1 ε (figure 4) and all the samples are on a single fractionation line (figure 5). In a single incinerator, the volatile phases are systematically enriched in light isotopes by 0.7 ε unit relative to the residue phases. Samples containing both volatile and residue phases yielded an intermediate Cd isotopic composition. These results indicate that, for temperature of 900-1000 °C, α sol-gas is minimum 0.7 ε amu·

Normalised to ^{114} Cd

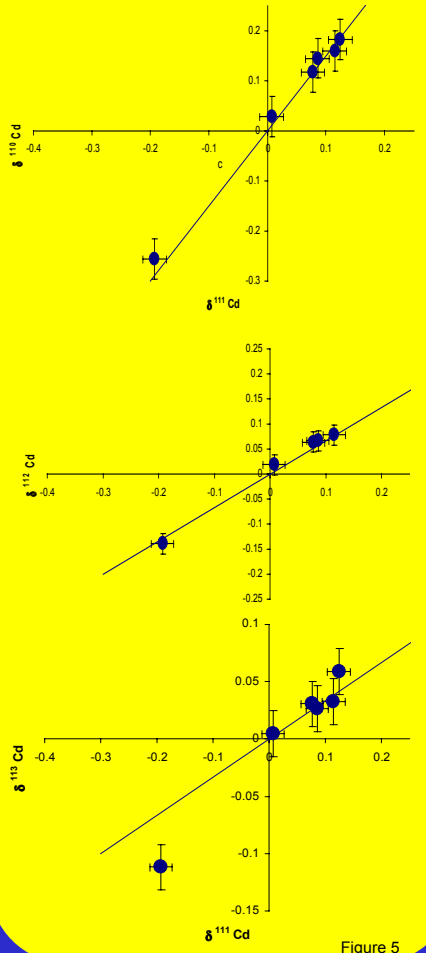

Figure 5

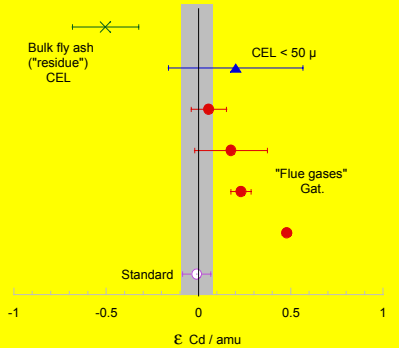

Figure 4

CONCLUSIONS

-Cd separation gives a 100 % recovery.

- After separation Cd is free of isobaric interference and its isotopic composition may be measured accurately.

-We have a high precision in the isotopic measurements of Cd, allowing to distinguish the Cd isotopic variation in terrestrial material.

- We should be able to survey the environmental pollution of the incinerator using Cd isotopic composition.

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