SECONDA UNIVERSITÀ DEGLI STUDI DI NAPOLI
SCUOLA POLITECNICA E DELLE SCIENZE DI BASE
DIPARTIMENTO DI MATEMATICA E FISICA

CENTRE FOR ISOTOPIC RESEARCH ON CULTURAL AND ENVIRONMENTAL HERITAGE

The role and the performance of CIRCE lab in the framework of the Isonitrate Italy Project

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The CIRCE lab

- A 3 MV accelerator mass spectrometer (AMS) for the ultrasensitive measurements of rare isotope ratios (e.g. actinides and ^{14}C).

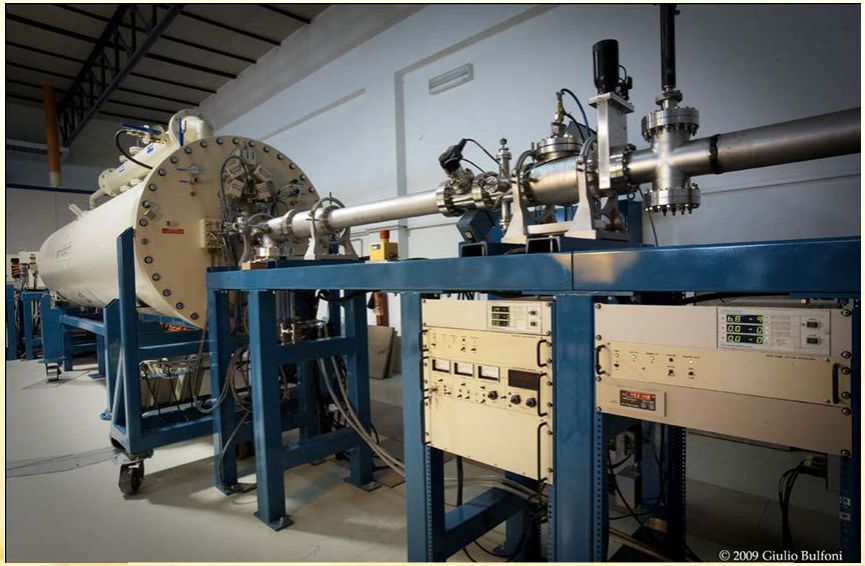
- A mass spectrometry lab (IRMS) for the stable isotope analysis of solid, gaseous and liquids samples.

- An environmental radioactivity laboratory allowing also the ^{222}Rn and gamma emitters measurement.

- An isotope chemistry lab involved also in methodological developments (e.g AMS measurement of ^{11}B).

- An isotope hydrology and cryogenic lab.

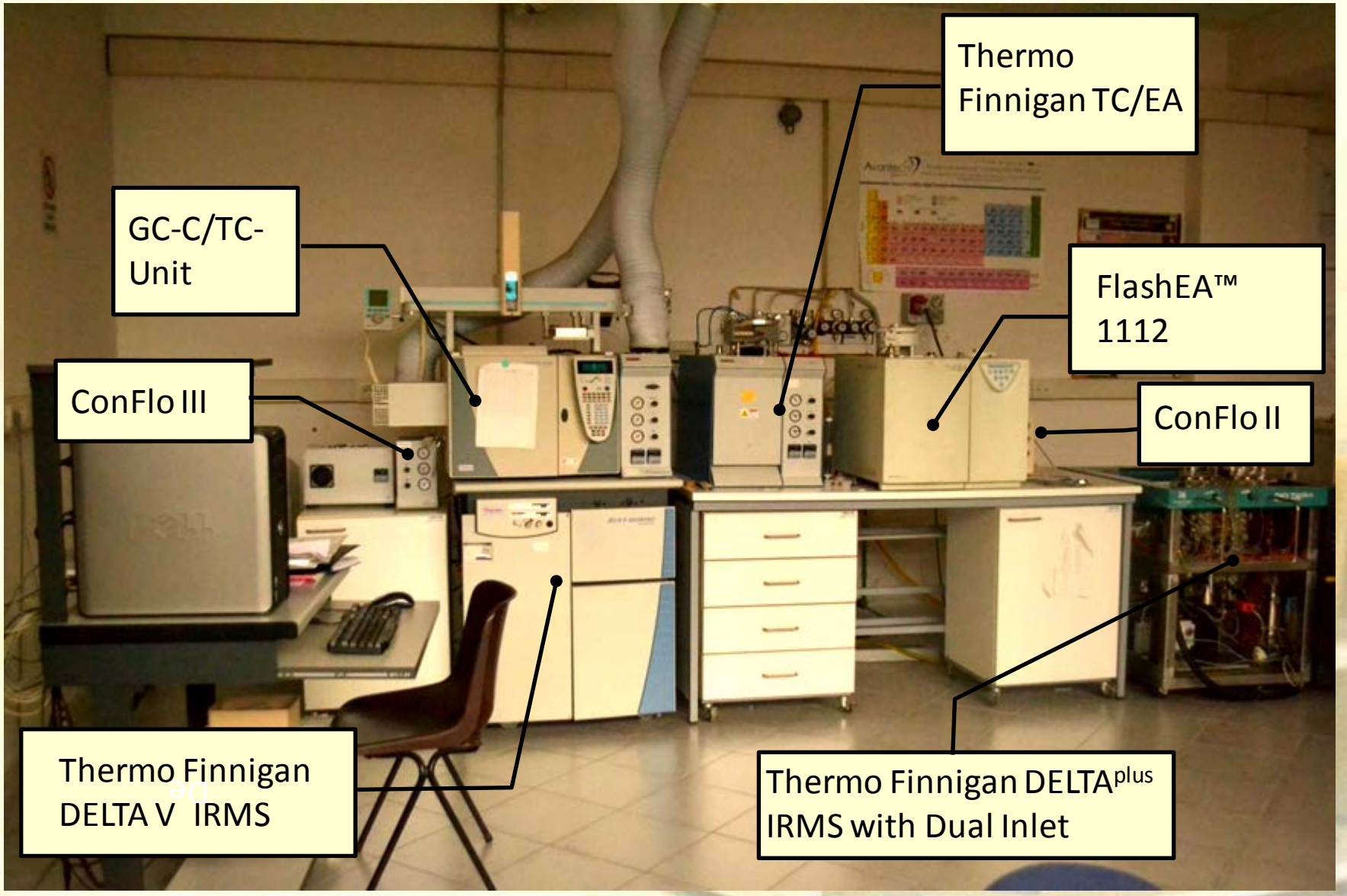
- A facility for the study of nuclear reactions in the framework of nuclear astrophysics.



CIRCE - FIELDS OF ACTIVITY

a) Archaeometry by high-precision radiocarbon dating;
b) Environmental science by ^{14}C-based global carbon cycle studies;
c) Isotope hydrology;
d) Nuclear astrophysics by the ERNA recoil mass separator;
e) Nuclear safeguards and contrast to illegal nuclear fuel use by actinides AMS;
f) Forensic applications of AMS;
g) Tribology by ^{7}Be implantation.

The IRMS lab


Thermo Finnigan TC/EA
GC-C/TC-Unit
FlashEA™ 1112
ConFlo III
ConFlo II
Thermo Finnigan DELTA V IRMS
Thermo Finnigan DELTA^plus IRMS with Dual Inlet

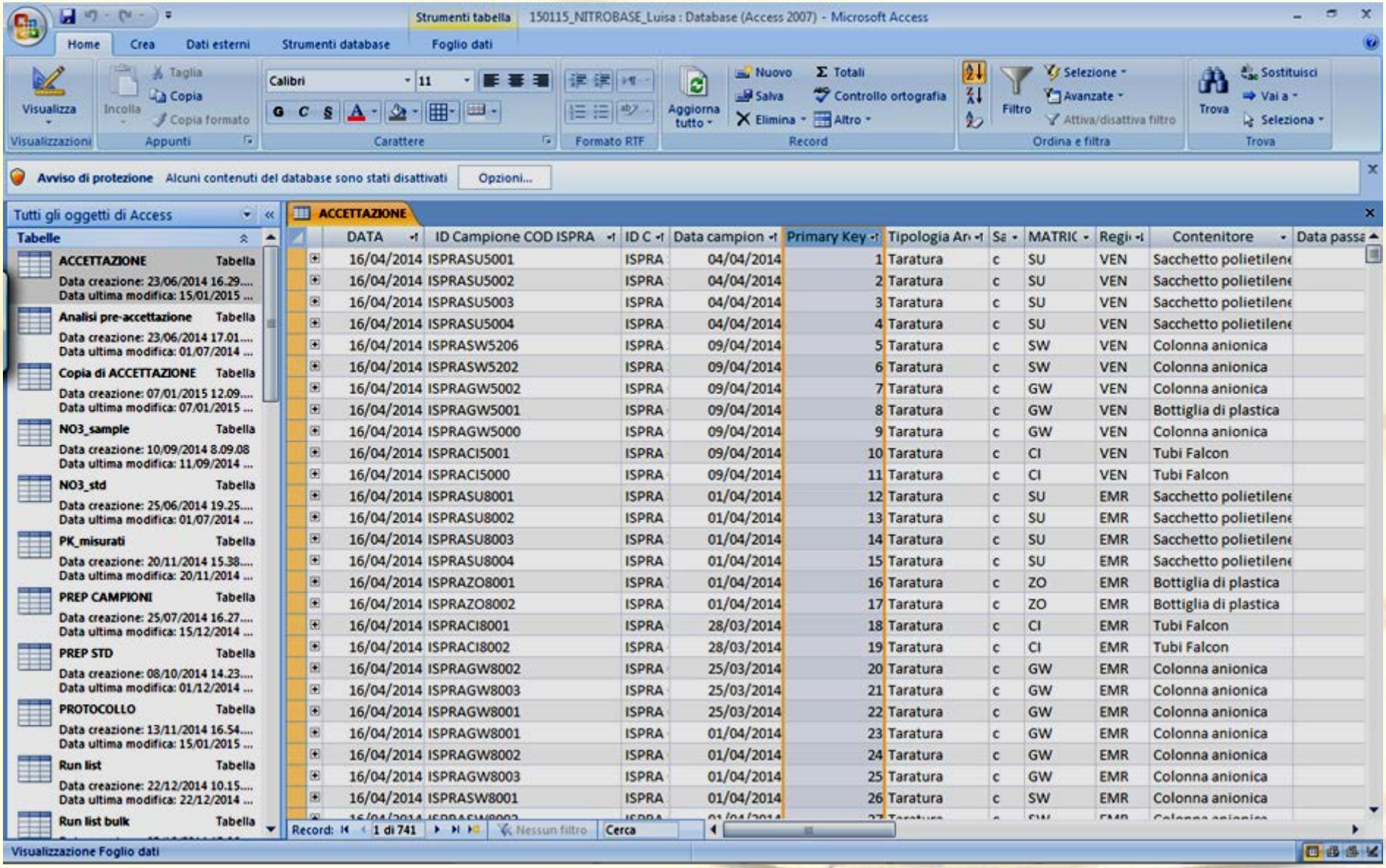
Number of isotopic analyses in the Isonitrate Italy project

Matrix	$\delta^{15}N_{NO3}$	$\delta^{18}O_{NO3}$	$\delta^{15}N_{BULK}$	$\delta^{11}B$
Surface waters	105	105		11
Groundwaters	361	361		74
Soils (2mm sieved and homogeneized)			54	
Soil extracts (1:5 soil to water ratio)	32	32		
Mineral fertilizers			2	
Manure			8	in progress
Sewage effluents (at inlet of TP)			12	in progress
Sewage effluents (at outlet of TP)	9	9		in progress

Total: **668 samples**

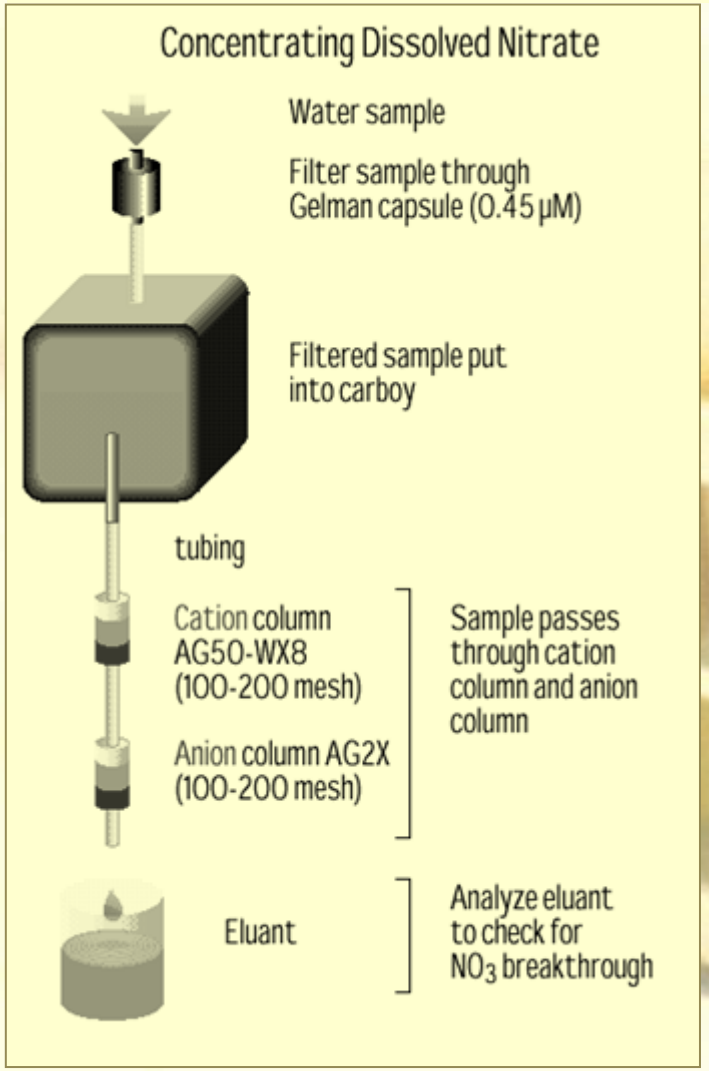
The environmental samples and isotopic analyses in the Nitrate Project

The samples reception: the Nitrobase

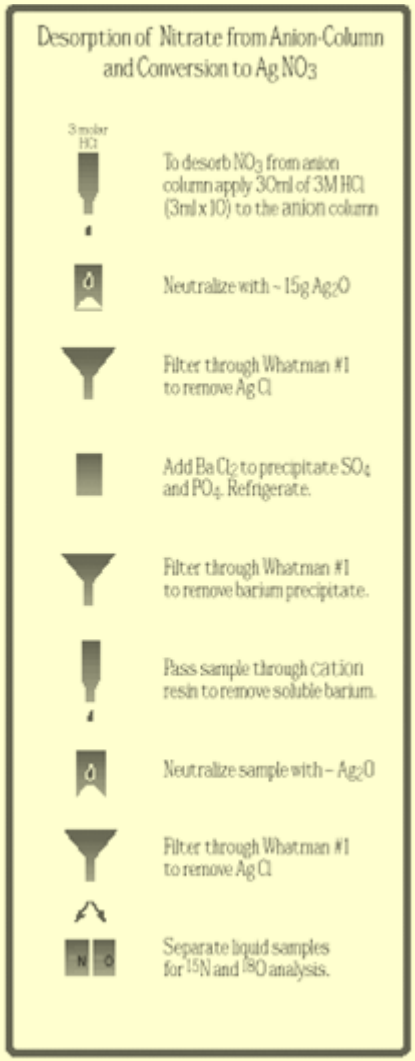


The Silver Nitrate method (Silva et al., 2000) for $\delta^{15}N_{NO3}$ and $\delta^{18}O_{NO3}$ analyses

Pretreatment



Protocol



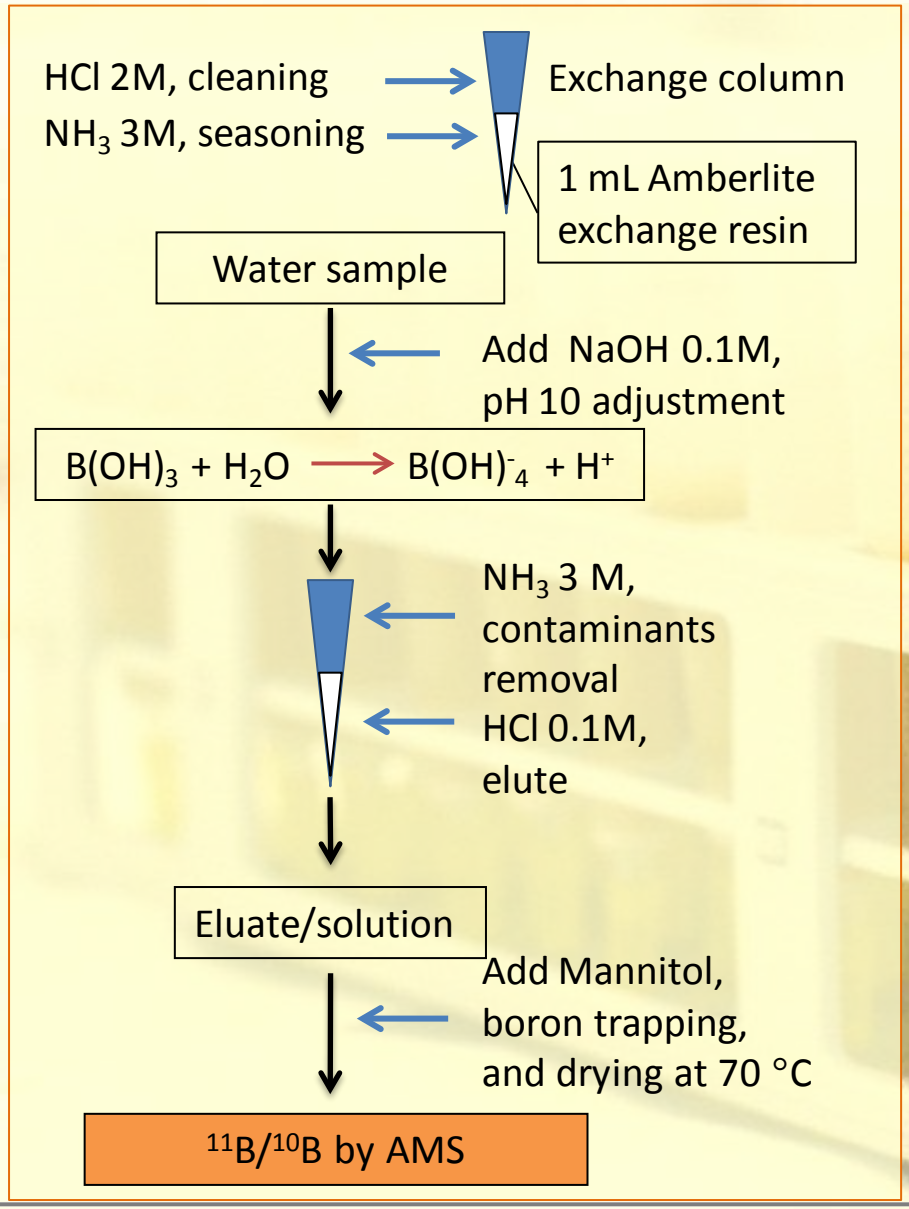
Minimum quantity of NO_3^-:

6 mg (100 µmol)

3 Internal Reference Materials (**RM**) in two replicates processed along with **Unk**nown samples:

1) **USGS 34** ($\delta^{15}N$=-1.8±0.2‰; $\delta^{18}O$=-27.9±0.6‰);
2) **SiAl KNO_3** ($\delta^{15}N$=26.9±0.8‰; $\delta^{18}O$=23.8±0.1‰);
3) **CIRCE KNO_3 3** ($\delta^{15}N$=2.5±0.5‰; $\delta^{18}O$=24.8±0.5‰).

The preparation protocol for $\delta^{11}B$ analyses



Minimum quantity of B required:

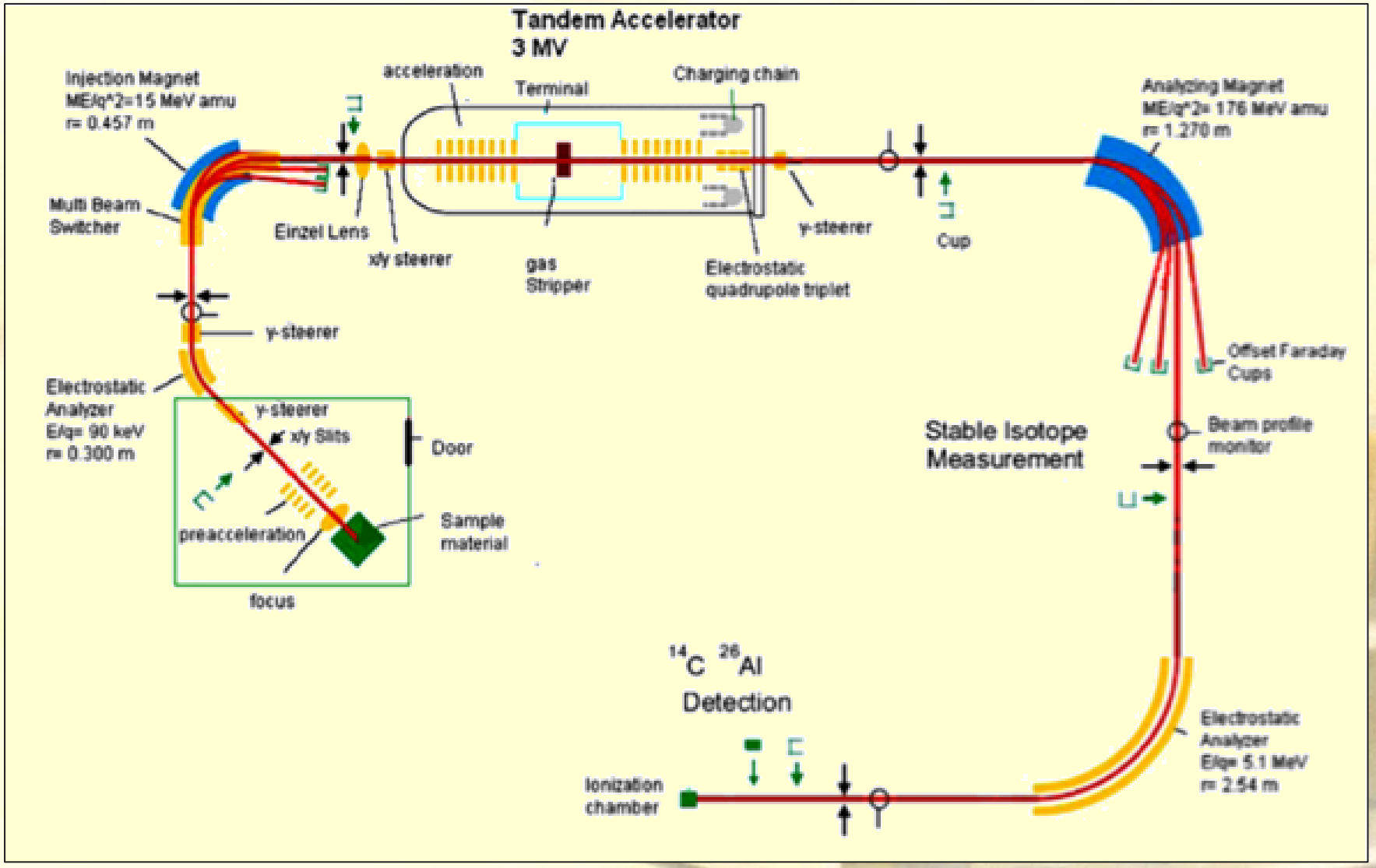
500 µg

International Reference Materials (**RM**) in 5 replicates processed along with **Unk**nown samples:

NIST951 ($\delta^{11}B$=0 ‰)

$$\delta^{11}B[‰] = \left[\frac{R_{sample}}{R_{SRM\ 951}} - 1\right] \times 1000$$

The AMS analysis of $\delta^{11}B$



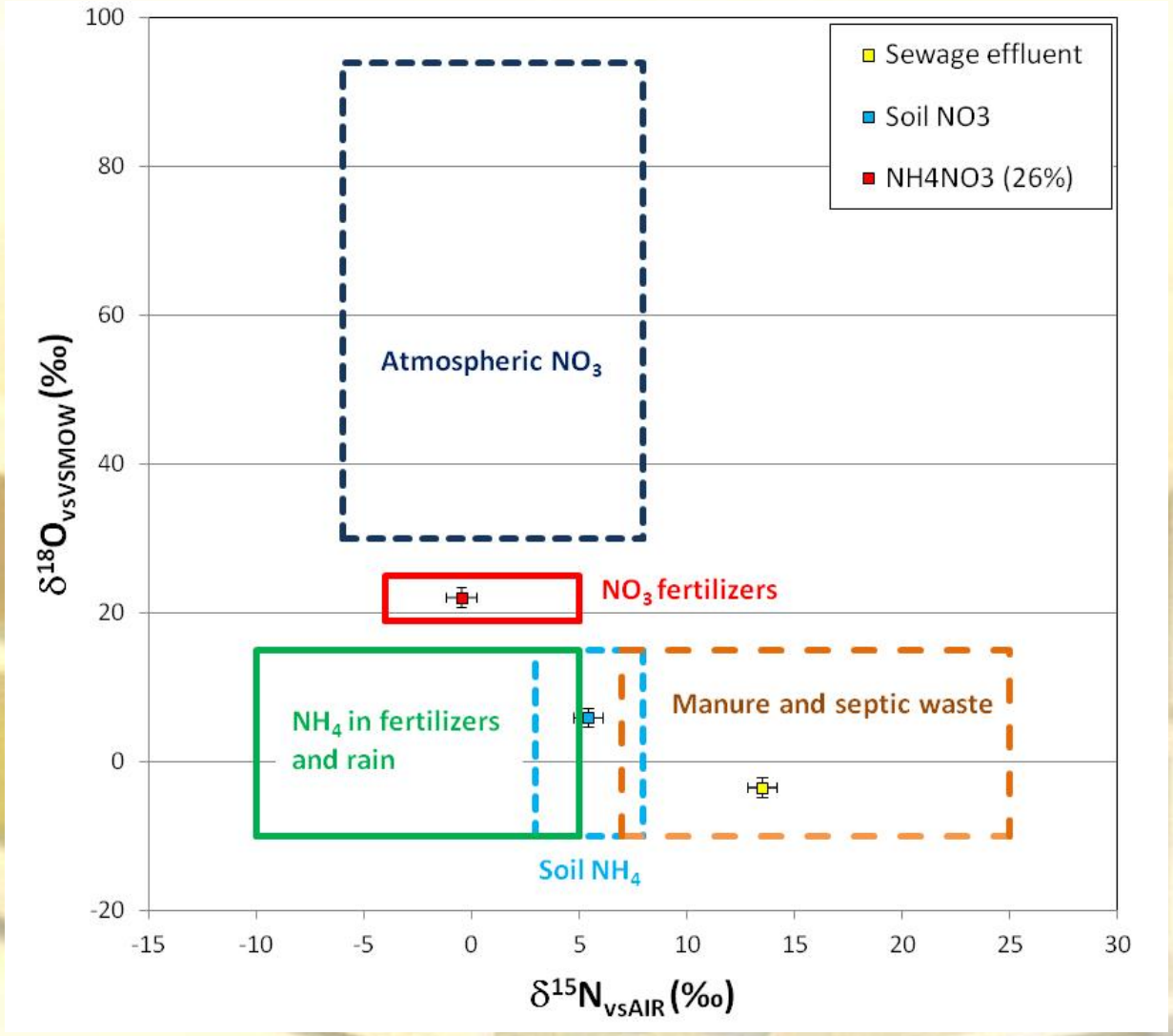
The isotopic analyses: Measurement performances

Measurement precision:

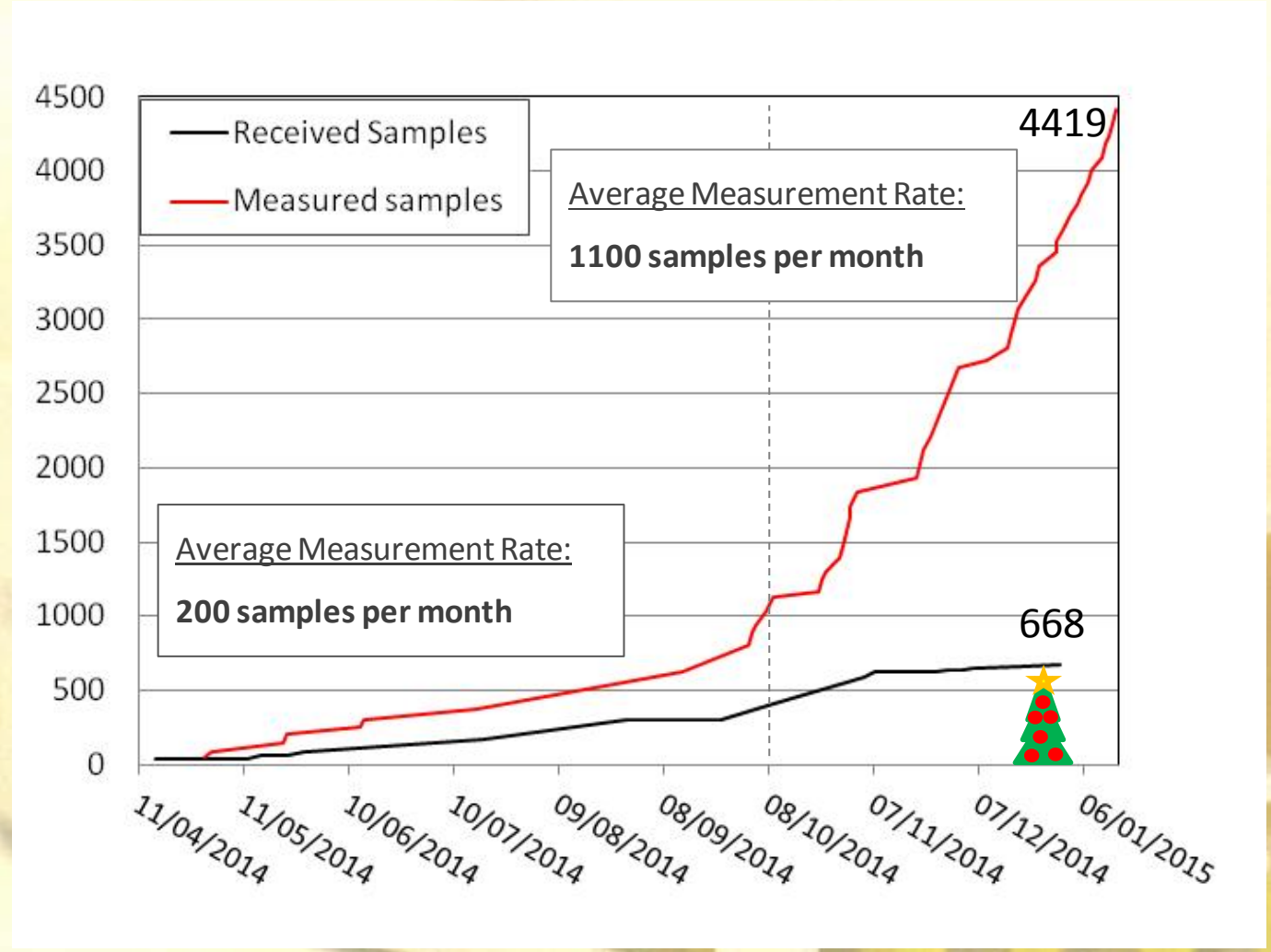
$\delta^{15}N_{NO3}$ = **± 0.7 ‰**

$\delta^{18}O_{NO3}$ = **± 1.3 ‰**

$\delta^{11}B$ = **± 6 ‰**

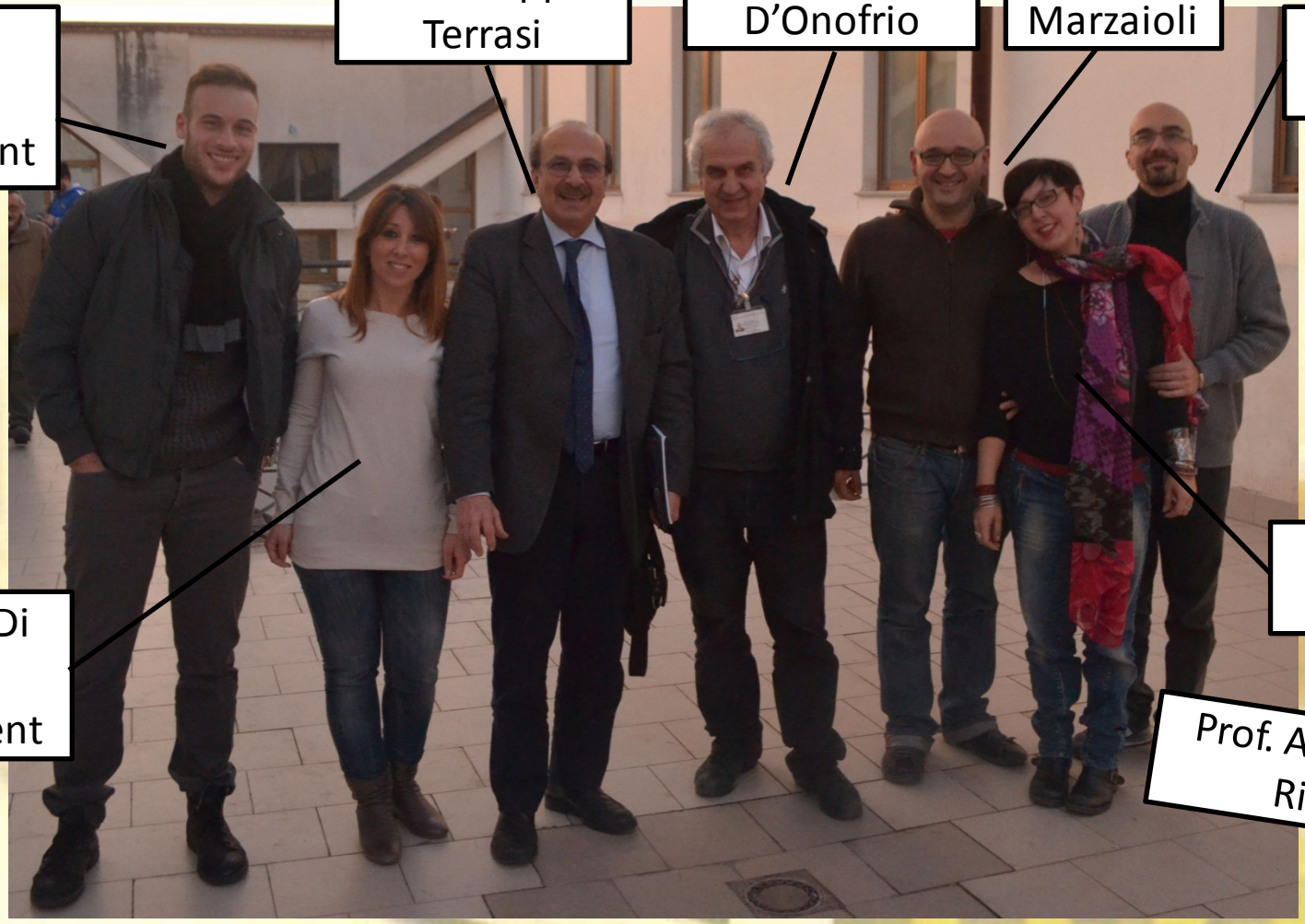


Throughput of the CIRCE lab for the Isonitrate Italy project



Average Measurement Rate: **510 samples per month**

The CIRCE working group



(Artwork made of TC/EA consumables)