

Overview on ICS-REM exercises, lessons learned and their implications

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**The European Commission's
science and knowledge service**

Joint Research Centre



European
Commission

The Joint Research Centre at a glance

Since 2016:

No more institute names!

~~IRMM, ITU, IPSC, ...~~

JRC-Geel

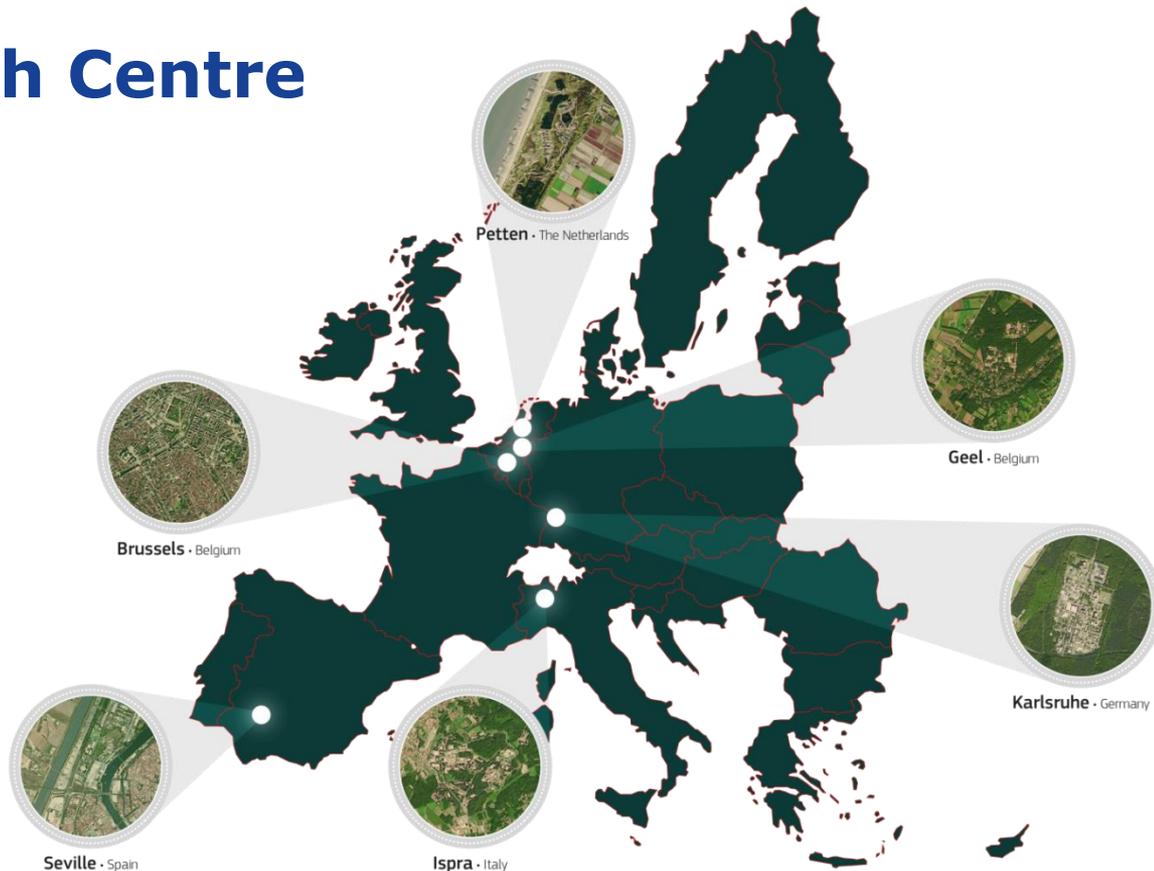
JRC-Karlsruhe

JRC-Ispra

JRC-Petten

JRC-Seville

JRC-Brussels



Work conducted in directorates
distributed over the 6 sites in 5 Member States

Article 35/36 Experts meeting Sept. 18-19, 2018

Treaty establishing the European Atomic Energy Community (Euratom)*

Article 8

After consulting the Scientific and Technical Committee, the Commission shall **establish a Joint Nuclear Research Centre**.

This Centre shall ensure that the research programmes and other tasks assigned to it by the Commission are carried out.

It shall also ensure that a **uniform nuclear terminology** and a **standard system of measurements** are established.

It shall set up a **central bureau for nuclear measurements (CBNM)**.

⇒ IRMM ⇒ **JRC-Geel:**

- Primary standardisation of radioactivity
- Decay data
- Realisation of the unit becquerel (Bq)

* Consolidated version of the Euratom Treaty 2016/C 203/01:

<http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02016A/TXT-20160901>



EURATOM Treaty (Art.8 and Annex V)

JRC "shall include a central bureau for nuclear measurements specialising in

- nuclear measurements for isotope analysis
- and absolute measurements of radiation
- and neutron absorption".

3 – Nuclear Data for safety of present-day and innovative nuclear energy systems

measurements of neutron induced reactions and cross-section standards

2 – Radionuclides and Radioactivity

activities for the harmonisation of the European radioactivity measurement system

1 – Metrological tools for nuclear safeguards

research in mass spectrometry, production of reference materials and ILC for nuclear safeguards

Treaty establishing the European Atomic Energy Community (Euratom)

Article 35

Each Member State shall establish the facilities necessary to carry out continuous **monitoring of the level of radioactivity in the air, water and soil** and to **ensure compliance with the basic standards**, defined in Article 30.

The Commission shall have the right of access to such facilities; it may **verify their operation and efficiency**.

Article 36

The appropriate authorities shall **periodically communicate information** on the checks referred to in Article 35 to the Commission so that it is kept informed of the level of radioactivity to which the public is exposed.

⇒ **JRC-Geel**

- Organisation of proficiency tests
- Production of reference materials

⇒ **JRC-Ispra**

- Environmental monitoring network (EURDEP)

⇒ **Results to Directorate-General for Energy**



Treaty establishing the European Atomic Energy Community (Euratom)

Article 39

The Commission shall set up within the framework of the **Joint Nuclear Research Centre**, as soon as the latter has been established, a health and safety documentation and study section

This section shall in particular have the task of collecting the documentation and information referred to in Articles 33, 36 and 37 and of **assisting the Commission in carrying out the tasks assigned to it in Chapter 3.**

Rem. Chapter 3: Articles 30-39 (health & safety)

Overview of EC PTs organised by JRC-IRMM (2003-2014)

Year	Matrix	Radionuclide(s)	
2003	air filter	^{137}Cs	
2005	milk powder	^{40}K , ^{90}Sr , ^{137}Cs	
2008	mineral water	$^{226/228}\text{Ra}$, $^{234/238}\text{U}$	
2010	soil	^{40}K , ^{90}Sr , ^{137}Cs , $^{212/214}\text{Bi}$, $^{212/214}\text{Pb}$, ^{226}Ra , $^{230/232}\text{Th}$, $^{234/235/238}\text{U}$, $^{238/239/240}\text{Pu}$	
2011	bilberry	^{40}K , ^{90}Sr , ^{137}Cs	
2012	drinking water	gross alpha/beta	
2014	air filter	^{137}Cs	

Proficiency Tests in support of Article 35

Complementary to DG ENER verifications

2011 Bilberry ^{90}Sr , ^{137}Cs , ^{40}K



2012 Water Total α / β activity



2014 Air filter ^{137}Cs



2016 Air filter MetroERM ^{134}Cs , ^{137}Cs , ^{131}I

2017 Maize ^{40}K ^{134}Cs , ^{137}Cs , ^{131}I

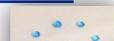
Also: First emergency exercise!

2018 Water Radon

2019 Water Total α / β activity and/or ^{210}Pb ^{210}Po



2020 e.g. air filter e.g. ^{134}Cs , ^{137}Cs , ^{131}I , ^{106}Ru



2020 Water Radon – Sampling!

First Sampling exercise???

Preliminary / suggestions



JOINT RESEARCH CENTRE

Radioactivity Environmental Monitoring

[European Commission](#) > [JRC](#) > [REMon](#) > [Services](#) > [Proficiency Tests](#)

[REMon](#)[About](#)[Services](#)[Maps](#)[Share](#)

Services

[Getting Authorized](#)[Installing Widgets](#)[Using Connect API](#)[Proficiency Tests](#)

EC-JRC Proficiency Tests for Radioactivity Environmental Monitoring Laboratories (EC-JRC REM PTs)

On the basis of the EURATOM treaty Articles 35-36, monitoring and reporting of environmental radioactivity is one of the EU member states' obligations. Article 39 stipulates that the JRC shall assist the Commission in carrying out the tasks in Chapter 3 on Health and Safety (Articles 30-39). To verify the quality and the comparability of measurement results delivered by member states laboratories, JRC-Geel organises Proficiency Tests (PTs) on the measurement of radionuclides in different environmental matrices. The EC-JRC REM (Radioactivity Environmental Monitoring) PTs are organised under a mandate from the European Commission's Directorate-General for Energy.

Ongoing Proficiency Test

REM 2018 Radon-in-water proficiency test

Table 1. Summary of EC-JRC proficiency tests

Table1. Summary of EC-JRC proficiency tests.

Year	Matrix	Radionuclide(s)	Status	Report
Tbd.*	Water	$^{210}\text{Po}/^{210}\text{Pb}$	Planned	
Tbd.	Water	Gross alpha/beta activity	Planned	
2018	Water	^{222}Rn	Announced for October	
2017	Maize powder	$^{134}/^{137}\text{Cs}$, ^{131}I	Completed	Being drafted
2016**	Air filter	$^{134}/^{137}\text{Cs}$, ^{131}I	Completed	Link
2014	Air filter	^{137}Cs	Completed	Link
2012	Water	Gross alpha/beta activity	Completed	Link
2011	Bilberry	^{90}Sr , ^{137}Cs , ^{40}K	Completed	Link
2010	Soil	^{40}K , ^{137}Cs , $^{212}/^{214}\text{Bi}$, $^{212}/^{214}\text{Pb}$, ^{226}Ra , $^{230}/^{232}\text{Th}$, $^{234}/^{235}/^{238}\text{U}$, $^{238}/^{239}/^{240}\text{Pu}$, ^{90}Sr	Completed	Link
2008	Water	$^{238}/^{234}\text{U}$, $^{226}/^{228}\text{Ra}$	Completed	Link



A dear child has many names

Naming of PTs in support of Article 35 carried out by JRC-Geel

- ILC – Interlaboratory Comparison
- PT – Proficiency Test
- REM – Radioactivity Environmental monitoring

Some names that appear:

- EC PT
- EC REM PT
- *Year ILC on analyte matrix* e.g. 2012 ILC on gross- α activity in water
- ICS-REM International Comparison Scheme – Radioact. Env. Monit.
- REM-ILC

JRC-GEE-REM-COMPARISONS@ec.europa.eu

2018 at JRC-Geel

Workshop+ Training course on radioactivity in feed



Benefits to stakeholders

- Independent evaluation of proficiency
 - Possibility to use results for accreditation (increasingly asked)
 - Obtaining (*for free*) a good quality Reference Materials with SI-traceable activity (*stable, homogeneous, transport issues clarified,...*)
 - Training course (*no fee*)
 - Workshop (*no fee*)
-
- Key benefits to DG ENER: Complementary to verification visit
 - Key benefit to population: Discovery of "gaps" ⇒ Better protection of the citizen.



JRC TECHNICAL REPORTS

Evaluation of the 2016 ENV57/MetroERM
measurement comparison on simulated
airborne particulates:
 ^{137}Cs , ^{134}Cs and ^{131}I in air filters

Timotheos Altitzoglou
Petya Malo

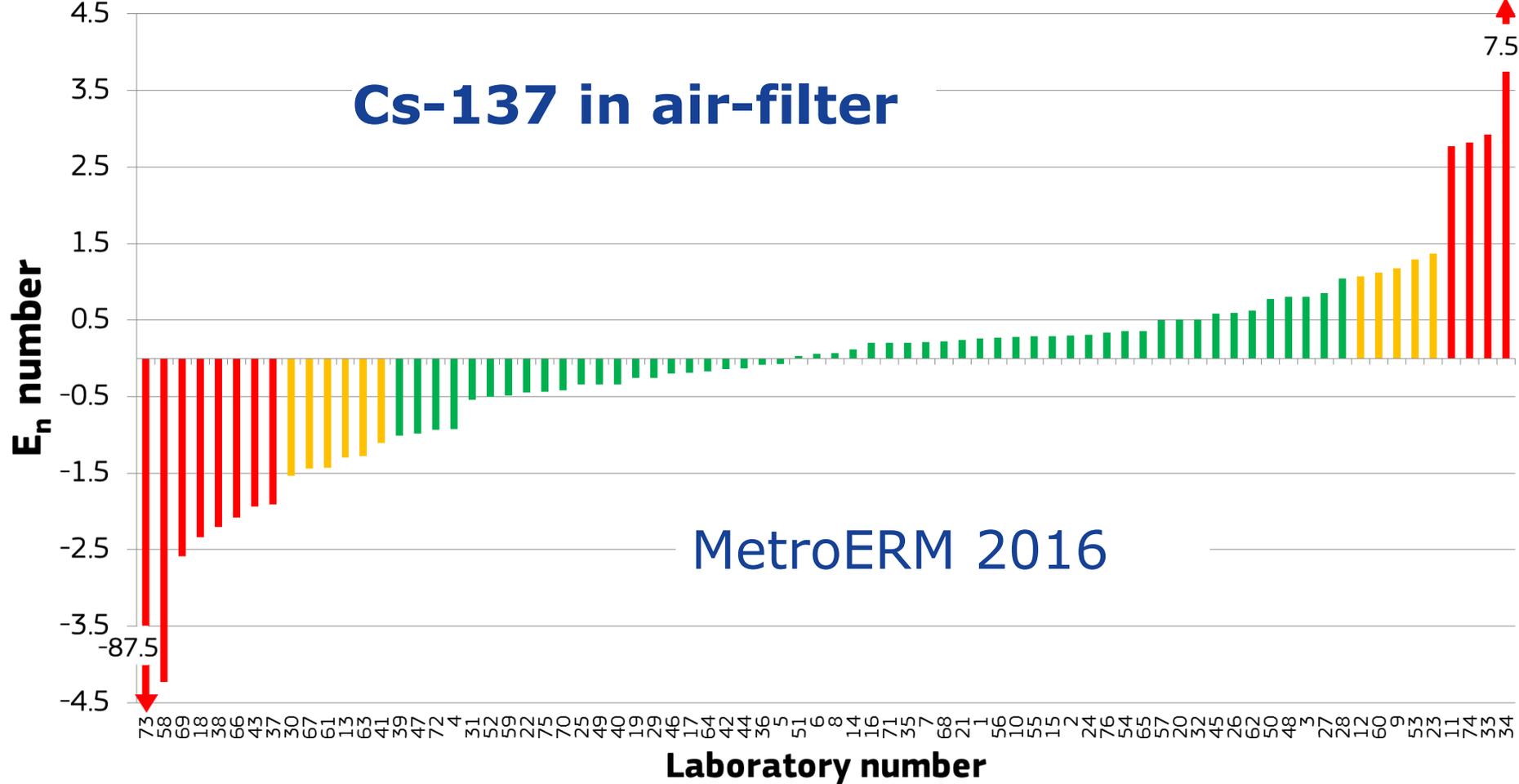
2017

EUR 29431 EN

Article 35/36 Experts meeting Sept. 18-19, 2018



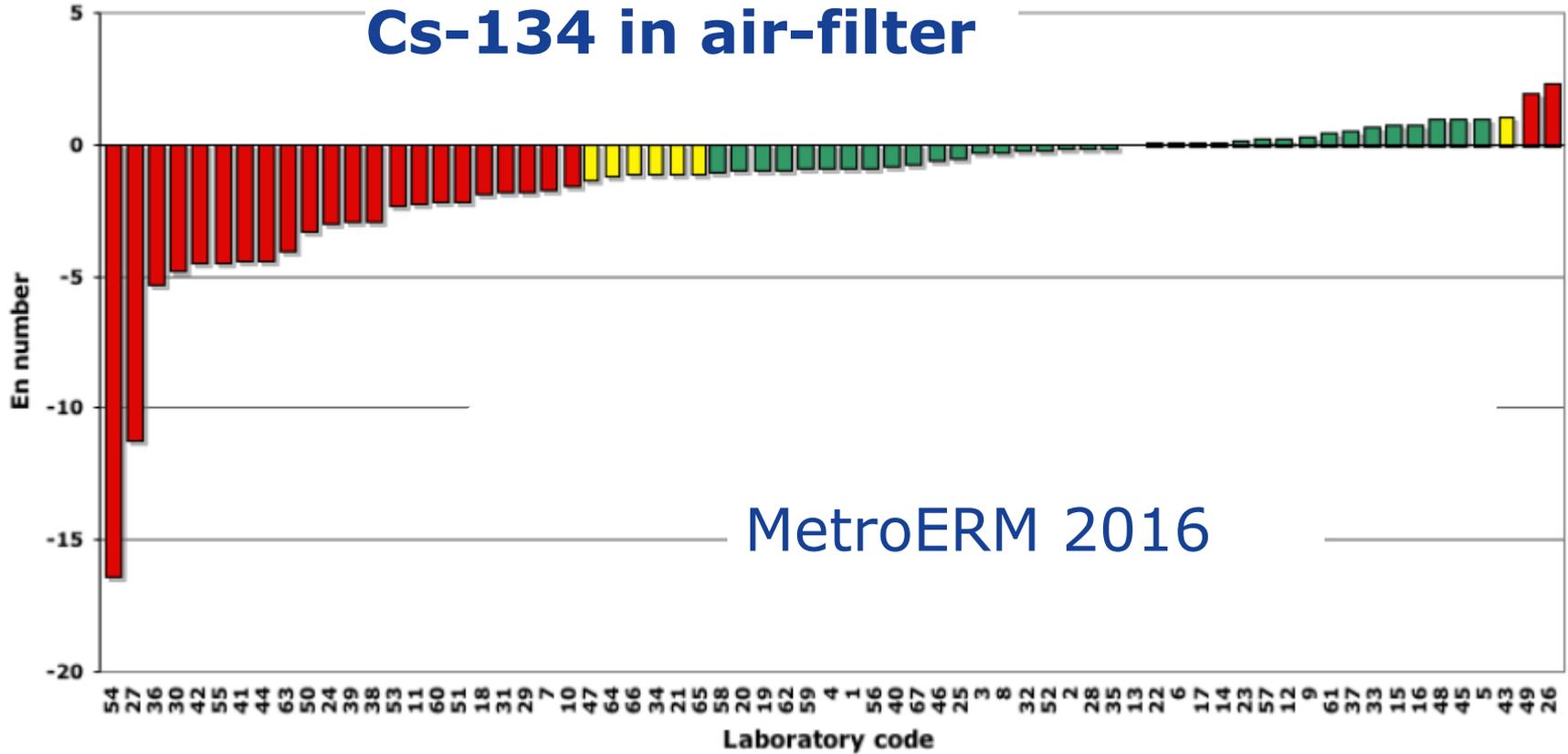
Cs-137 in air-filter



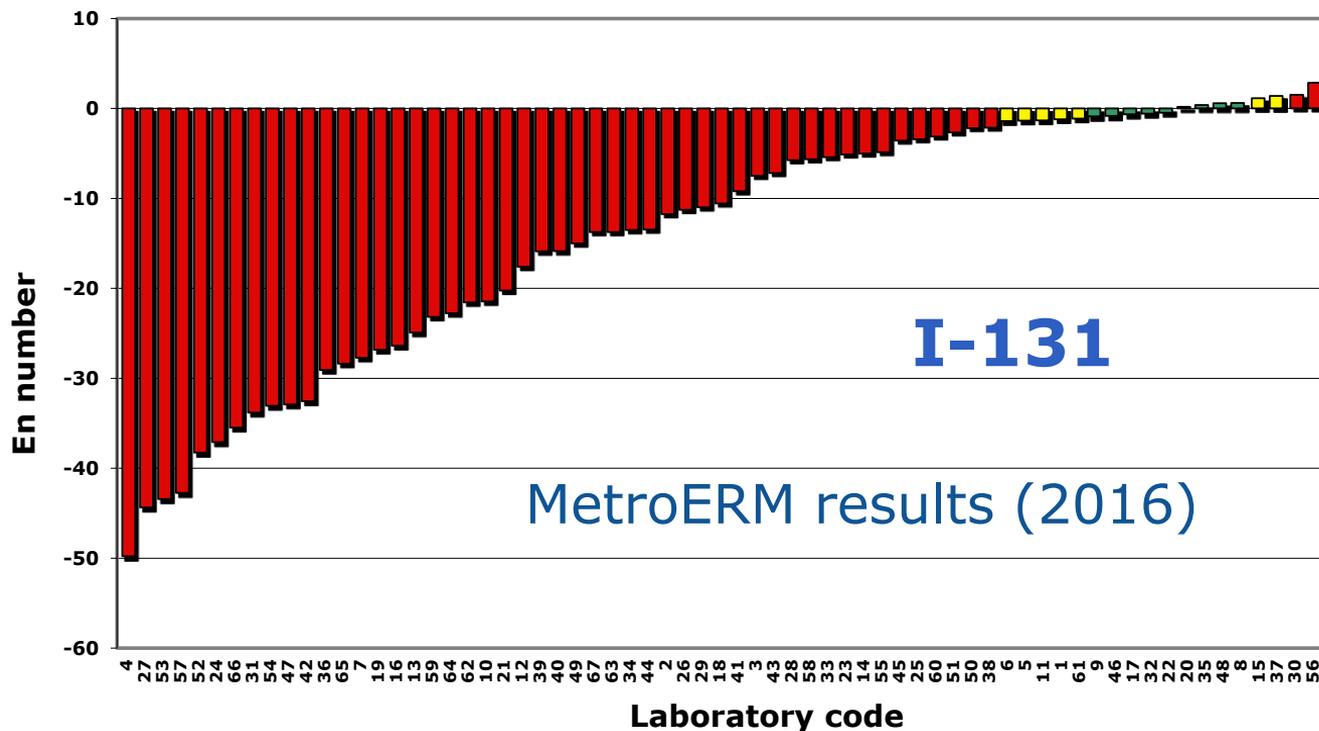
MetroERM 2016

Cs-134 in air-filter

MetroERM 2016



- Many reasons for reporting too low values: Different filters than used for iodine, no decay correction, heating the filter prior to measurement, removing the filter from the bag in which it was delivered,...



Reference value

$$E_n = \frac{A - A_0}{\sqrt{U(A)^2 + U(A_0)^2}}$$



JRC SCIENCE FOR POLICY REPORT

Evaluation of the 2012 EC interlaboratory comparison on gross alpha/beta activity concentration in drinking water

Viktor Jobbágy, Jana Mrešová,
Timotheos Aifantisoglou, Mikael Hult,
Petya Malin, Uwe Wätjen

2016



JRC
Institute
Director

EUR 20201 EN

19, 2018



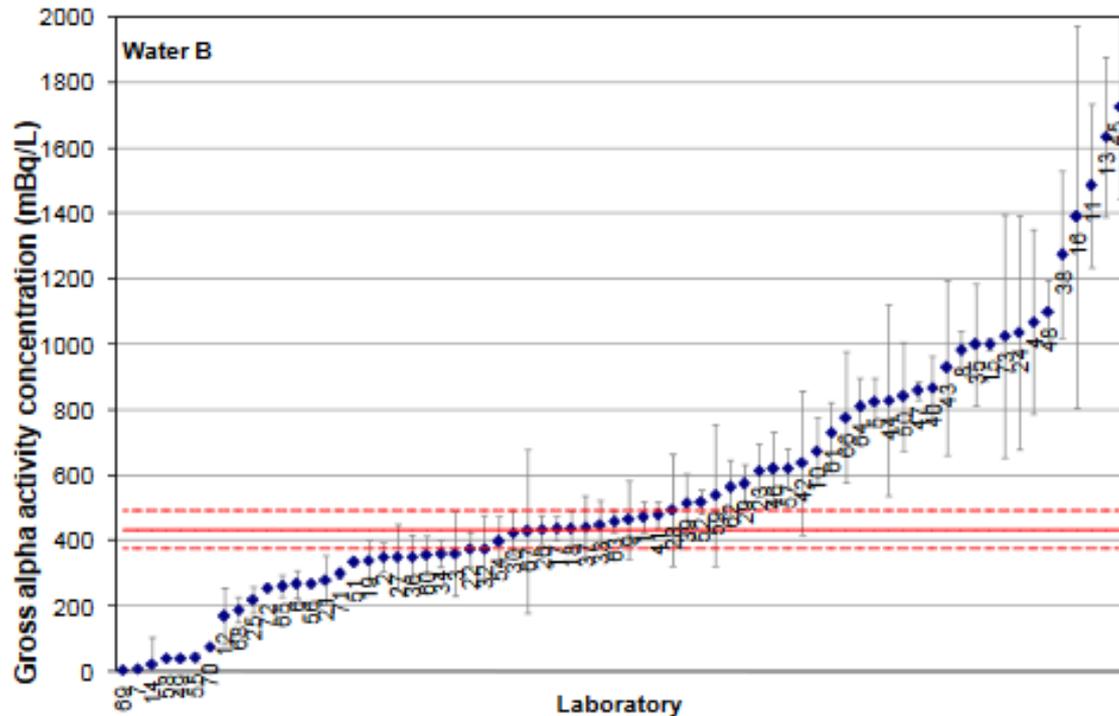


Fig. 22. Laboratory results for gross alpha activity concentration for Water B. The solid red lines indicate the reference activity concentrations (A_{ref}) of gross alpha activity. Their corresponding expanded uncertainties $\pm U_{ref}$ ($k = 2$) are plotted in dashed red lines.

Reasons for discrepancy

- *Instrumentation*
- *Procedures*
- *Personnel (education, experience, continuous training,..)*
- *Legal status*
- *Organisational structure*
- *International standards*

.....

Radionuclide metrology



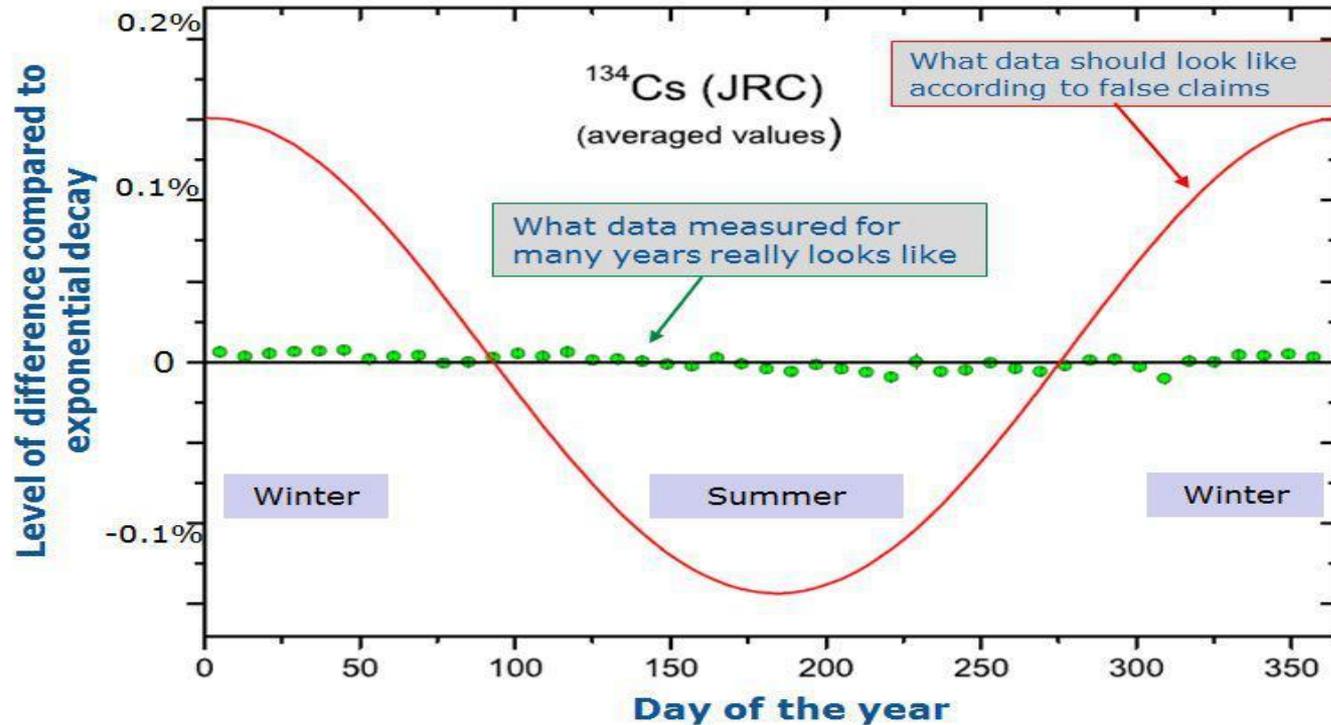
The Radionuclide Metrology Team of JRC-Geel acts as a hub in implementing equivalence and harmonisation of radioactivity measurements.

JRC Scientific Excellence Award to Stefaan Pommé

Category 1: Scientific Excellence



Invariability of decay constants



With 14 NMIs!
Endorsed by CCRI
Disproving claims of permille level solar influence on radioactive decay
-
Immense impact,
(which will not reach the news)

8 recent articles in, Phys. Lett. B 761 + Metrologia 54
+ Solar Phys. 292 + Astropart. Phys. 97,



International metrology in the field of Ionizing Radiation

Overview

Units

Committee structure

Strategic plan

BIPM laboratory work

→ Ionizing radiations are present in many aspects of life today, including both radiations occurring naturally in the environment – such as from radionuclides found in air (radon decay products), soils, food, water and the human body, as well as cosmogenesis and cosmic rays – and artificially produced radiations such as found in:

- medical uses of X-rays (kV tubes and MV accelerators), gamma rays from external beam/brachytherapy sources and from short-lived radionuclides used in nuclear medicine (^{99m}Tc , other SPECT, PET radionuclides), as well as other emerging techniques (e.g. hadron and neutron therapies),
- nuclear industry cycle, discharges and waste,
- radioactive fallout from nuclear industry emergencies and nuclear weapons testing,
- irradiation facilities using gamma sources (^{60}Co , ^{137}Cs) or electron accelerators for sterilization (food, medical equipment), industrial radiography or radiation processing for environmental remediation (flue gas, wastewater, sewage sludge),
- scientific research facilities for high-energy photon/particle beams, or low-energy X-ray photons in nanotechnology.

↘ Ionizing Radiation

- ➔ Overview
- ➔ Measurement units
- ➔ Committee structure
- ➔ Strategic plan

↘ International equivalence

- ➔ Calibration and measurement capabilities (CMCs)
- ➔ International comparisons

↘ At the BIPM

- ➔ BIPM laboratory work
- ➔ Ongoing BIPM comparisons
- ➔ International Reference

BIPM web-site

Ionising radiation (CCRI)

<https://www.bipm.org/metrology/ionizing-radiation/>

Key Comparison Data-base (~1000 entries)

<https://kcdb.bipm.org/>

Participation in Supplementary Comparisons

CCRI(II)-S13

Massic activity of Cs-134 and Cs-137 in wheat harvested in **Fukushima**. Provided by NMI-Japan.



γ -ray spectrometry above ground and in HADES.

External access to JRC infrastructure

You find all instructions at

<https://ec.europa.eu/jrc/en/research-facility/open-access>

select RADMET and you come to:...

<https://ec.europa.eu/jrc/en/research-facility/open-access/calls/relevance/2018-1-RD-EUFRAT-RADMET>

Call closing October 15. Open 2 times per year.

Or contact: Mikael.hult@ec.europa.eu

Methods/instruments for primary standardisation –Above ground – RADMET Lab.

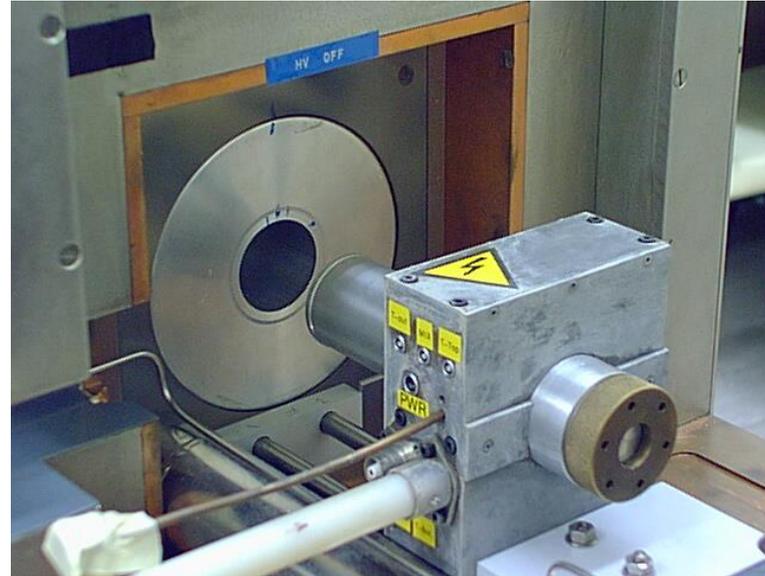
Method	Instrument
4π counting with a pressurised proportional counter	Small PPC, Large PPC
Coincidence counting with PC-2NaI, 2NaI	PPC, NaI well
4π beta gamma coincidence counting with SPPC-NaI well	PPC, NaI-well
4π beta gamma sum counting with a PPC and a NaI well detector	Small PPC, Large PPC, NaI well
4π gamma counting with a NaI well detector	NaI well
4π counting with a CsI sandwich spectrometer	CsI
X-ray counting at defined low solid angle	X-DSA
Alpha particle counting at defined low solid angle	α -DSA
Liquid scintillation counting	2 x Quantalus, 1 Packard

Three types

- high-geometry (4π) methods
- coincidence counting
- defined solid angle counting



"the old" and the new $4\pi\beta\text{-}\gamma$ -coincidence counter



Examples of ABOVE GROUND
Instrumentation RADMET Lab.

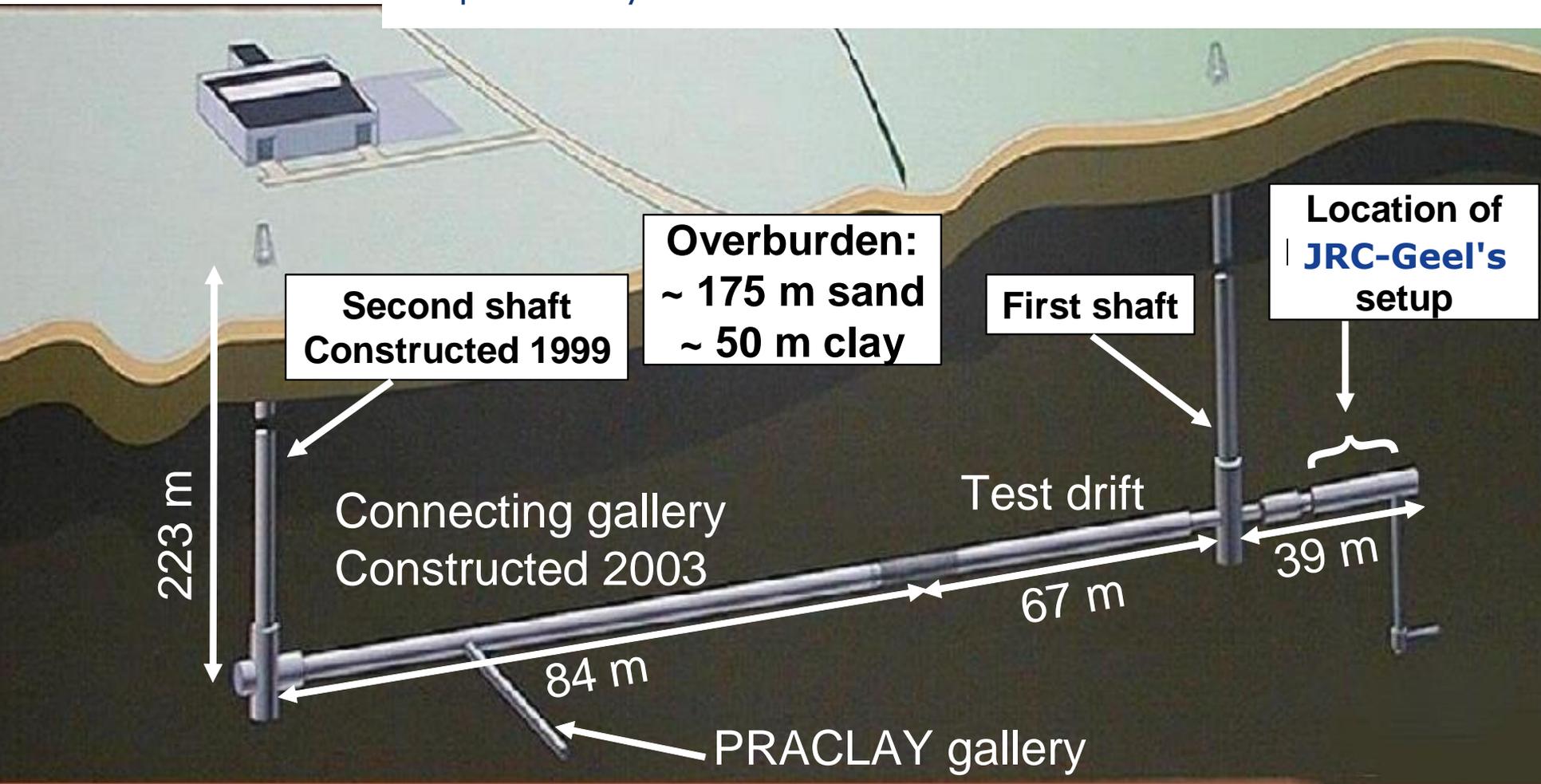
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European
Commission

HADES

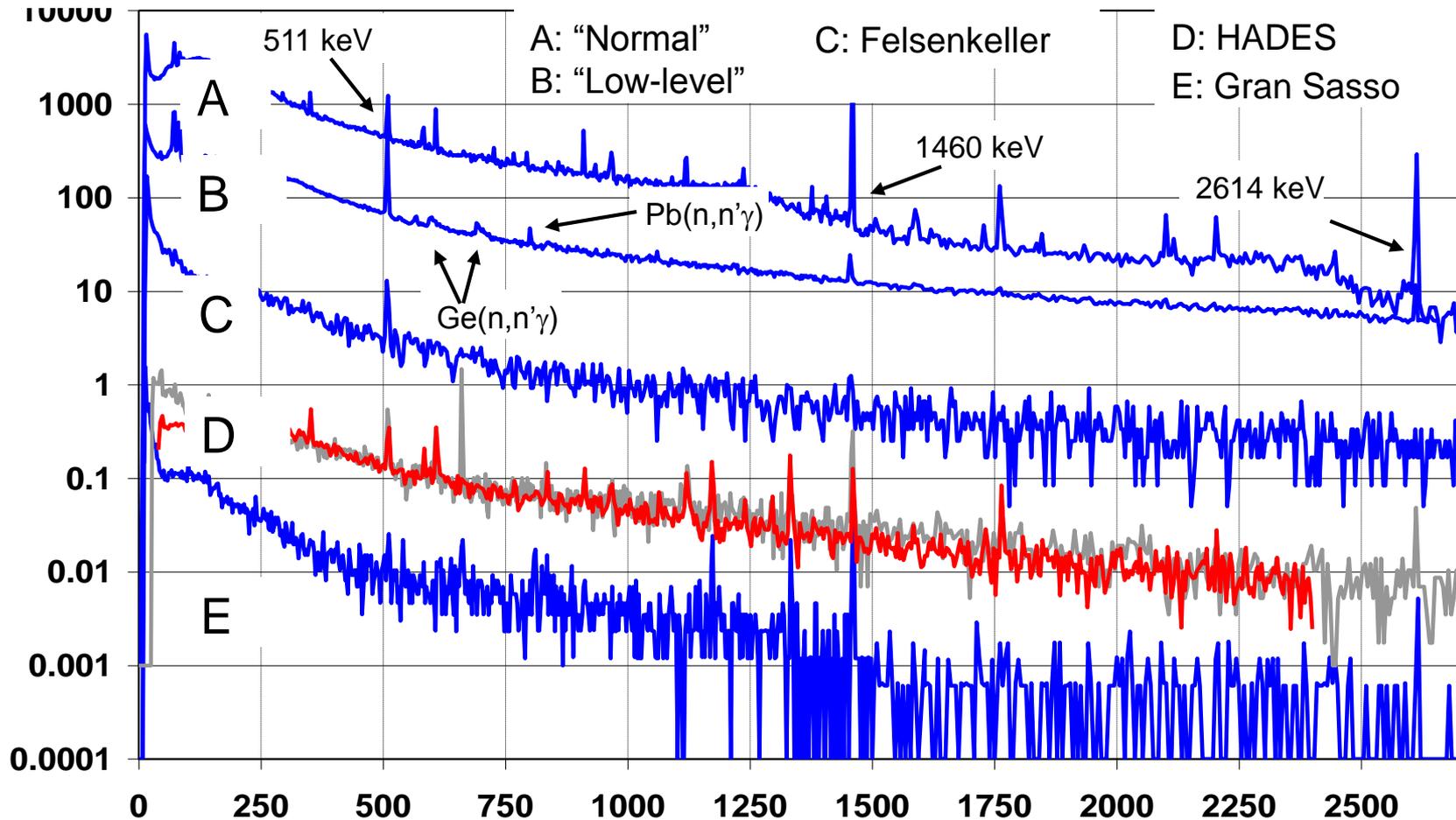
HADES = High Activity Disposal Experimental Site
- Operated by EURIDICE and located at SCK•CEN in Mol







Background Comparison – Gamma-ray spectrometry



HADES providing fundamental data to project supporting sustainable development goals



warm/cold water corals,
SSM,
Sweden

AWI/HCMR / Uni-
Bremen, Germany

Natural archives

Greenland ice

DTU,
Denmark

EUFROT: Studies of biota and environment in Antarctica

Baseline studies, uptake in food chain,
Ocean circulation, etc.

Polish Academy of
Science, Poland

Established
1977 on King
George Island



Article 35/36 Experts meeting Sept. 18-19, 2018

Henryk Arctowski Polish Antarctic Station



General view of Henryk Arctowski station



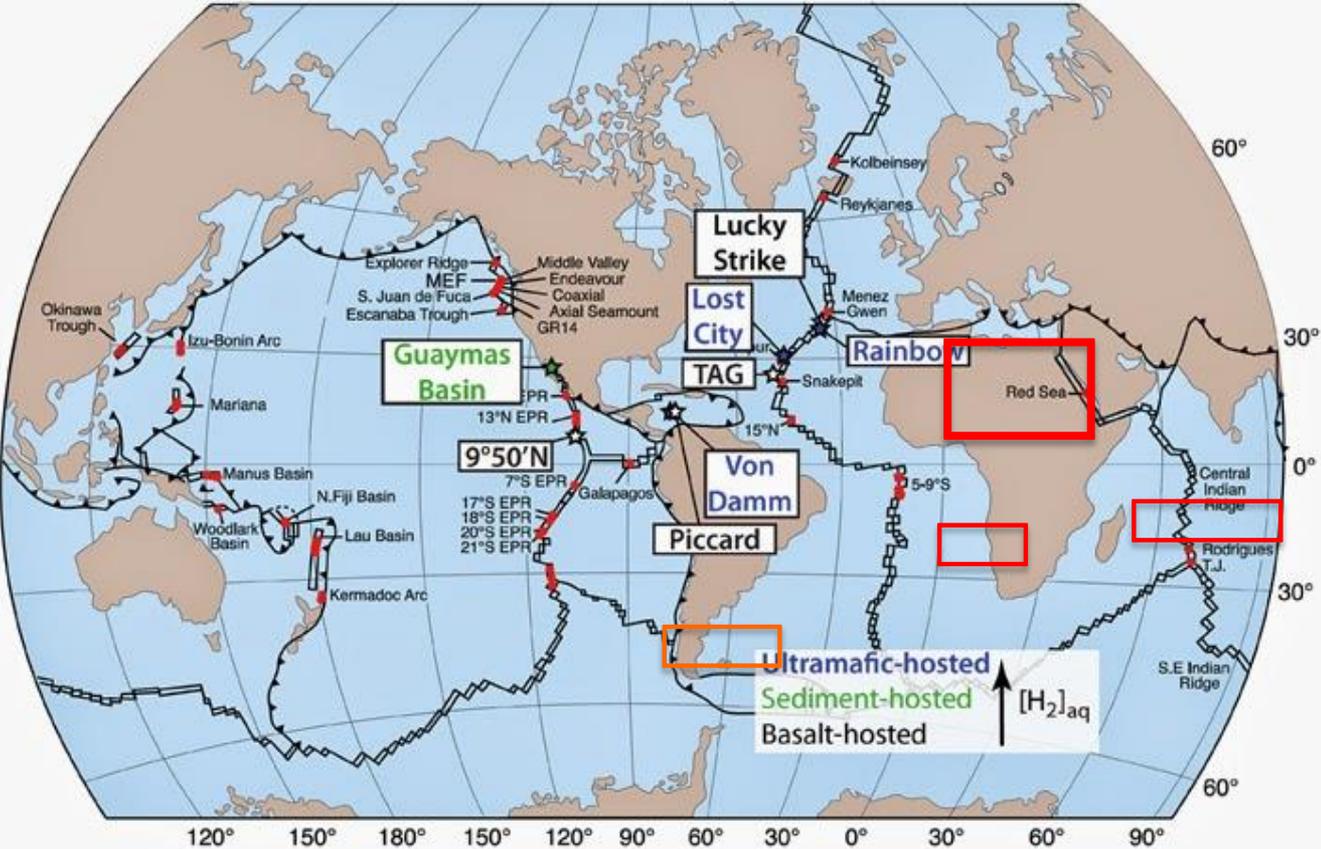
Study of impact of hydrothermal vents

LAFARA, France and
WHOI, USA

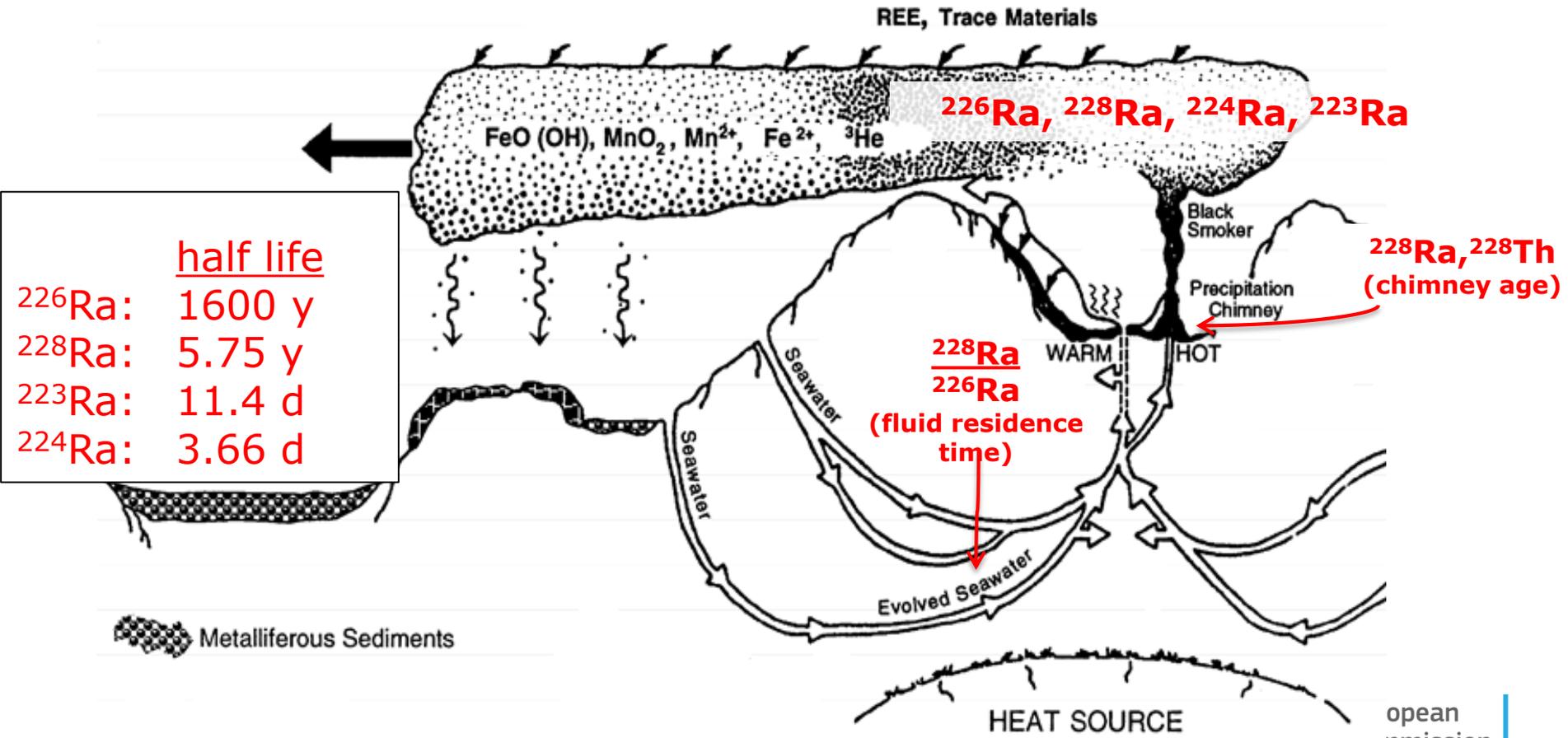
<https://www.youtube.com/watch?v=mOtcpa4Ego4>

Image Credits: National Oceanography Centre, NOAA, WHOI, CMER

Hydrothermal fluids from vents on the Mid Atlantic Ridge & East Pacific Rise



Radionuclides have been used to determine time scales of hydrothermal processes; few studies...



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