



Results from the intercomparison measurements of sediment sample - exercise no 1.

Anna Rand and Trygve Olav Bjerk

*Institute for Energy Technology (IFE),
Kjeller, Norway*

Intercomparison exercise no 1.

Objectives:

- Determination of natural and anthropogenic radionuclides in a sediment sample

Sample distributed to the participants

Exercise 1

NKS GammaRay 2018

Sediment sample 10g for lab analysis

Sediment sample have been ashed at 450° C and homogenized.

Packaging 2 layer with plastic (outer layer Rn tight). Vacuum initiated 25. june.2018.

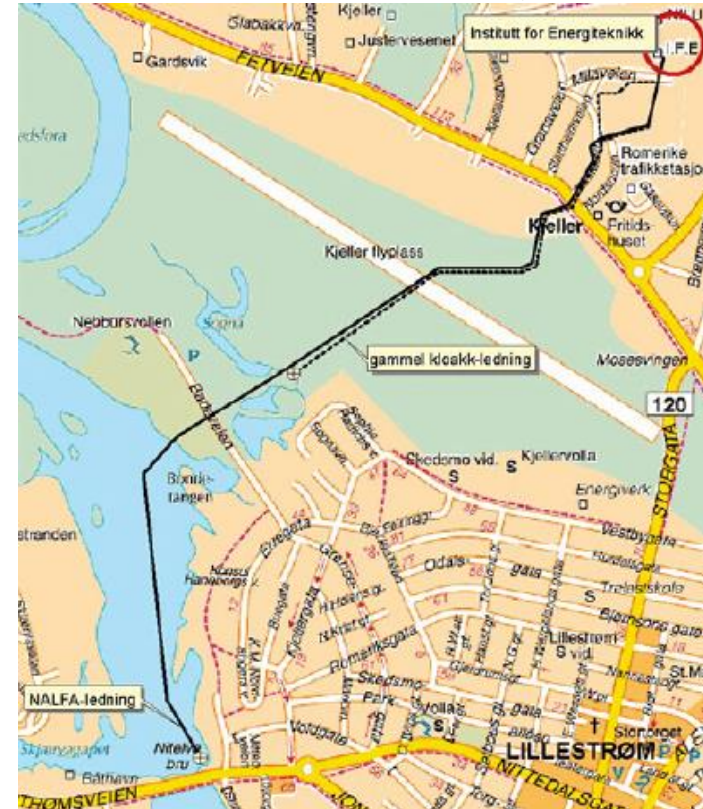
Reference date for reporting results 25. June 12:00.

Please send your results by Email before 1. September to: Anna.Rand@ife.no

9 Laboratories reported their results.

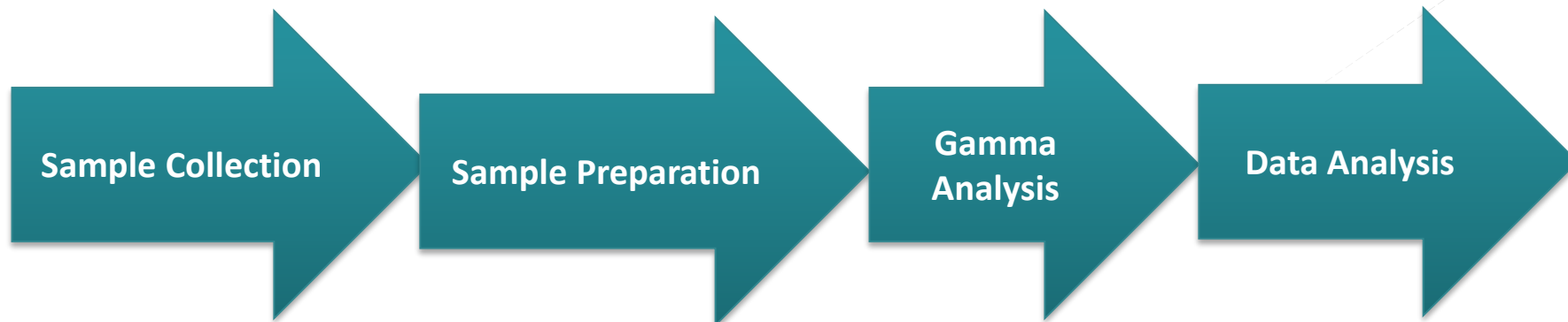
The sediment samples

- collection from manholes along the pipeline for low level radioactive discharges from IFE's nuclear activities at Kjeller, Norway
- contain natural and anthropogenic radionuclides
- Anthropogenic activity levels come from historic discharges



Map showing discharge pipeline from IFE Kjeller facilities

Sediment sample



October 2015

- Drying (105°C)
 - Sieving
 - Ashing (450°C)
-
- Homogenized
 - Vacuum packing
- HPGe-detector (Ortec & Canberra)
 - Gamma spectrometry analysis software: GammaVision from Ortec

- Sediment samples were put together and mixed to obtain enough sample material
- NO certified reference materials

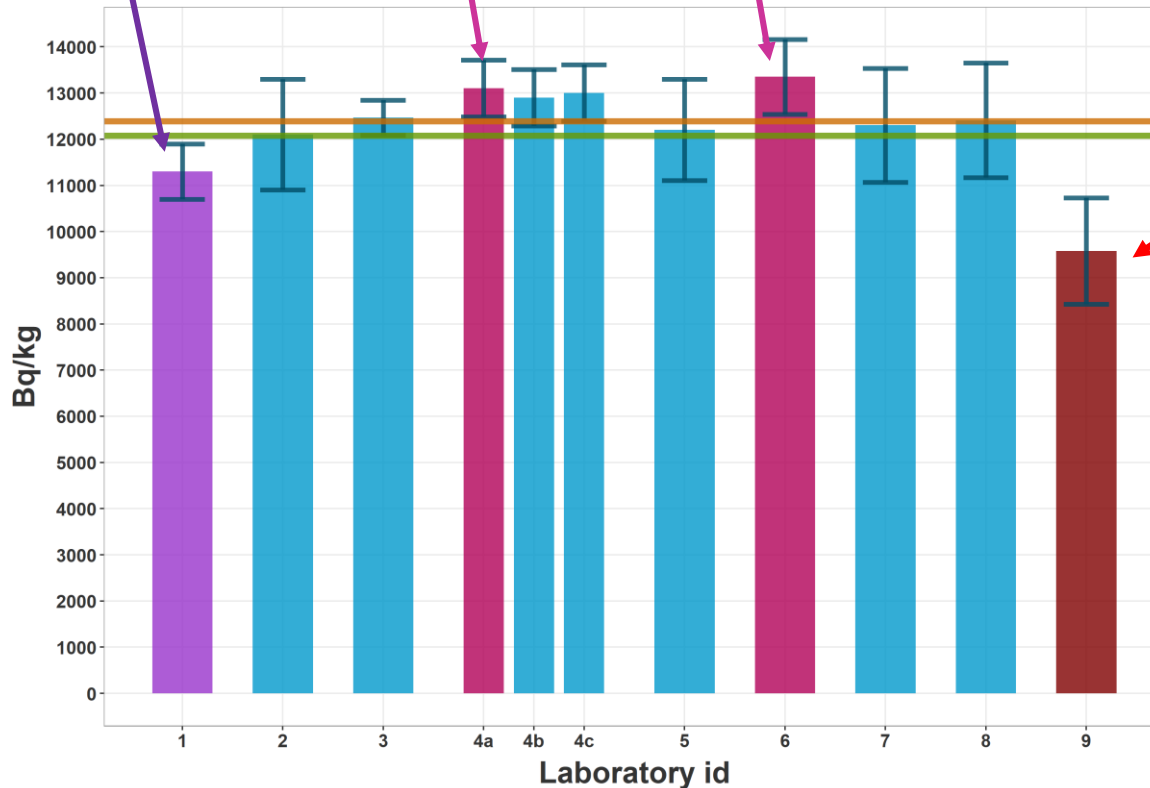
Radionuclides	Reported by number of lab
^{40}K	9 / 9
^{60}Co	9 / 9
^{137}Cs	9 / 9
^{226}Ra	8 (9) / 9
^{228}Ra (^{228}Ac)	8 / 9
^{210}Pb	7 / 9
^{241}Am	7 / 9
^{234}Th	6 / 9
^{214}Pb	5 / 9
^{152}Eu	5 / 9
^{212}Pb	4 / 9
^{228}Th	3 / 9
^{208}Tl	3 / 9
^{212}Bi	3 / 9
^{214}Bi	3 / 9
^{235}U	1 / 9
^{154}Eu	1 / 9

Reported results and their uncertainties for

95% CI of measure is above mean w/o outliers

95% CI below mean

¹³⁷Cs



Outlier: > 2 SD from mean

Reported by 9 labs.

Min: 9 580 ± 1150 Bq/kg
Max: 13 350 ± 810 Bq/kg

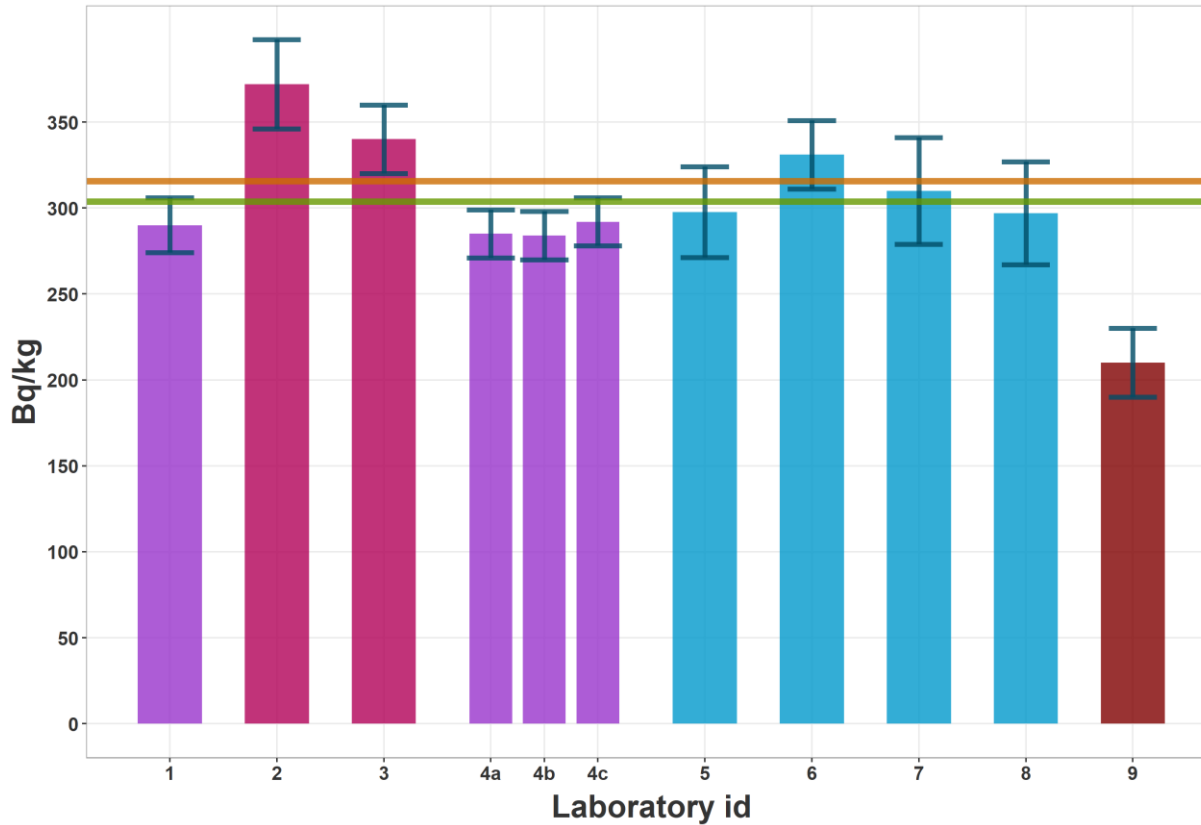
Average:
12 246 Bq/kg

Average without outliers:
12 513 Bq/kg

*Results: Activity ± Unc (k=2) [Bq/kg]

Reported results and their uncertainties for

⁶⁰Co



Reported by 9 labs.

Min: 210 ± 20 Bq/kg
Max: 372 ± 26 Bq/kg

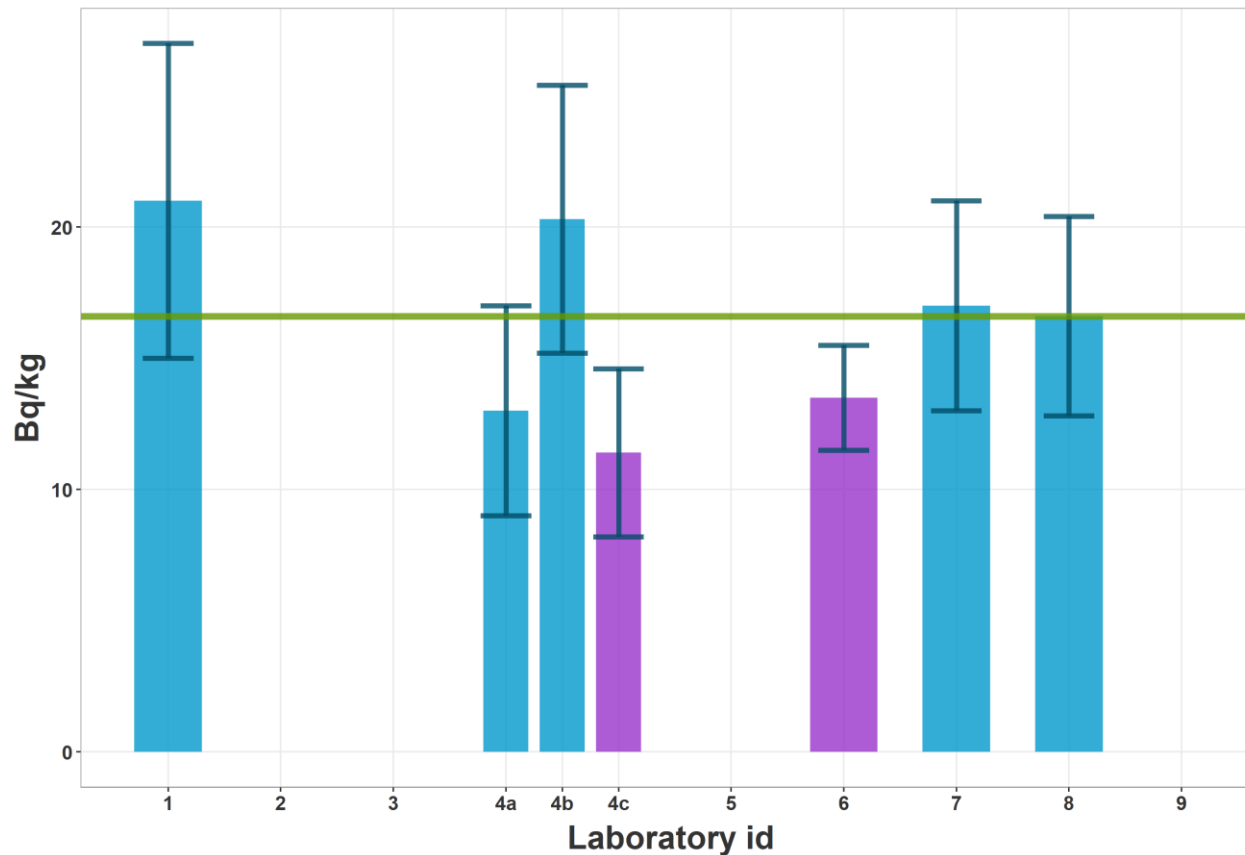
Average:
301 Bq/kg

Average without
outliers:
310 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for

¹⁵²Eu



Reported by 5 labs.

Min: $11,4 \pm 3,2$ Bq/kg

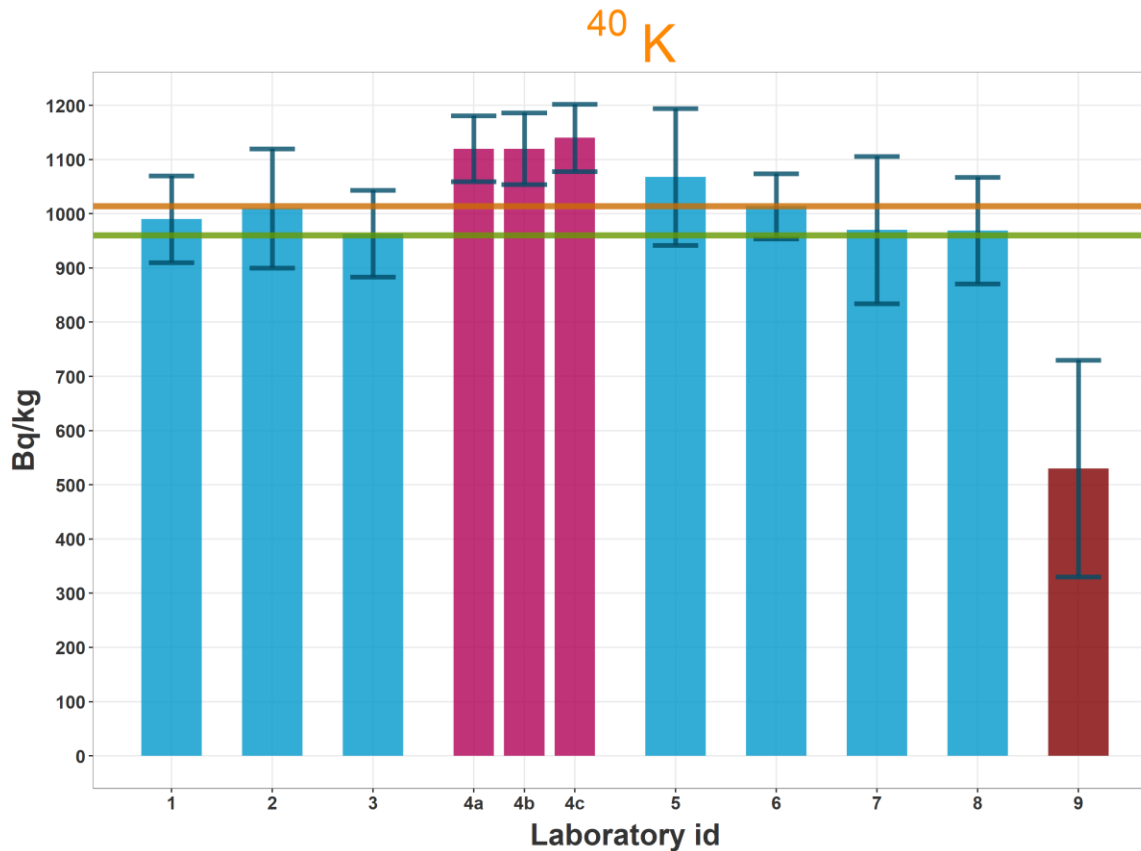
Max: 21 ± 6 Bq/kg

Average:

16 ± 4 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for



Reported by 9 labs.

Min: 530 ± 200 Bq/kg
Max: 1 140 ± 62 Bq/kg

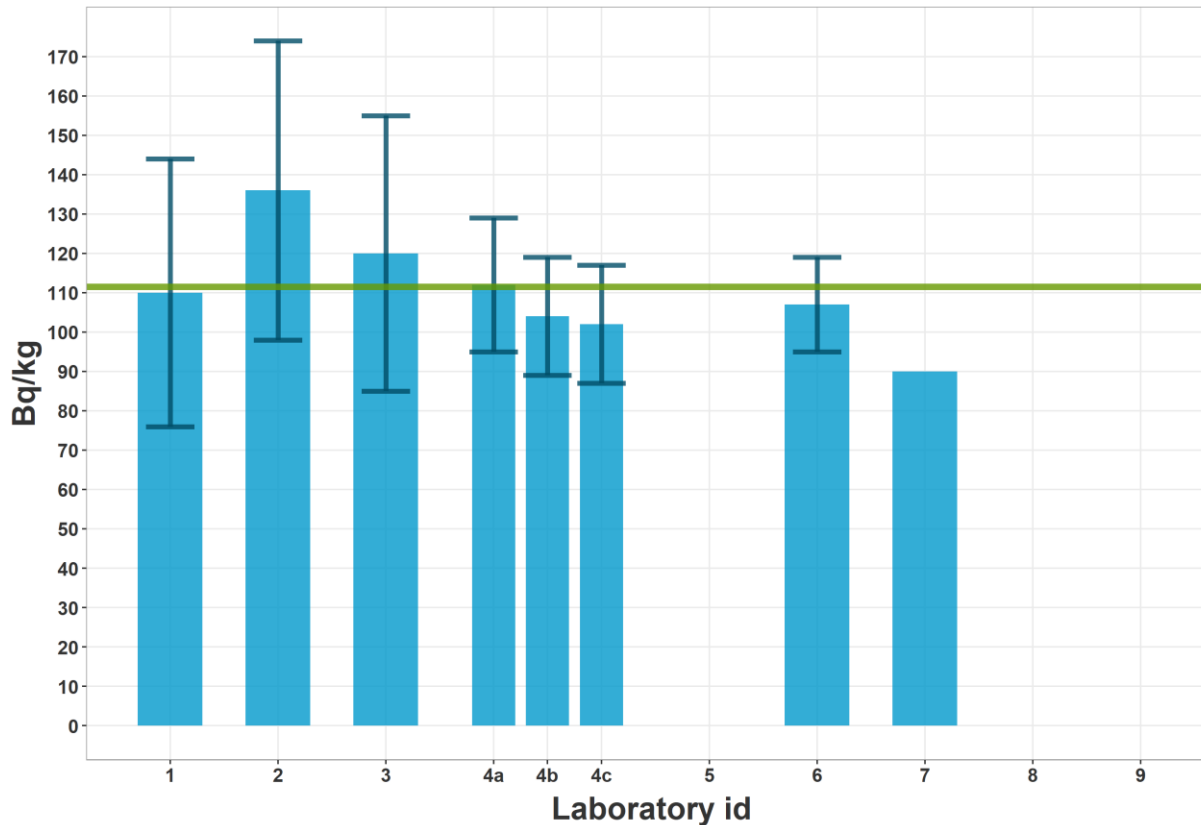
Average:
990 Bq/kg

Average without outliers:
1036 Bq/kg

*Results: Activity ± Unc (k=2) [Bq/kg]

Reported results and their uncertainties for

^{238}U (from ^{234}Th)



Reported by 6 labs.

Min: 90 Bq/kg

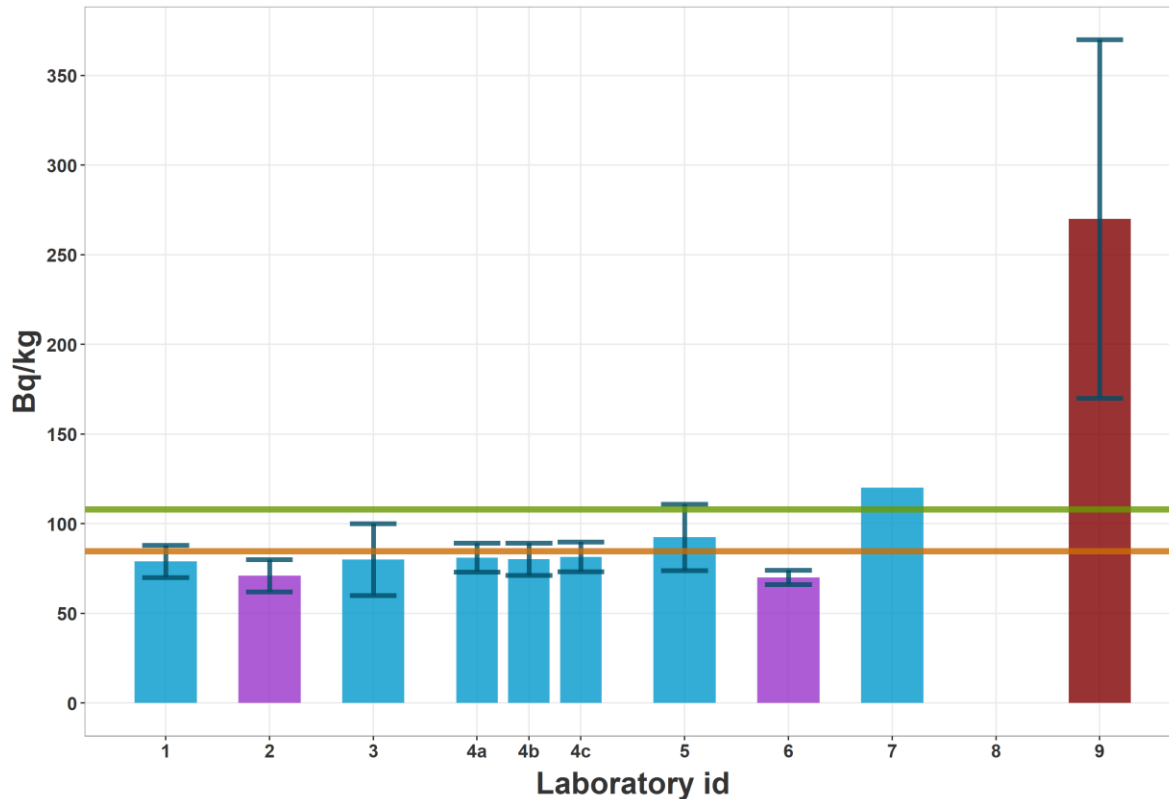
Max: 136 ± 38 Bq/kg

Average:
110 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for

²²⁶Ra



Reported by 9** labs.

Min: 70 ± 4 Bq/kg

Max: 270 ± 100 Bq/kg

Average:

103 Bq/kg

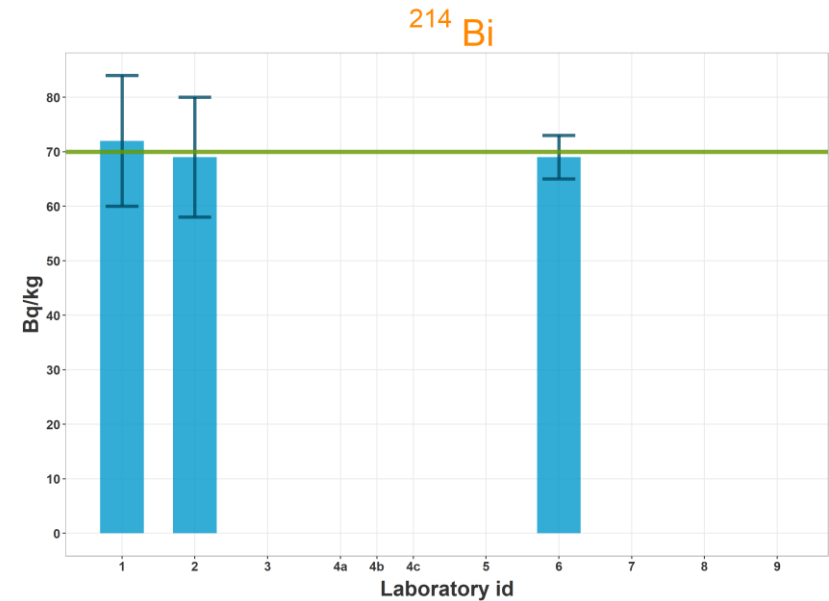
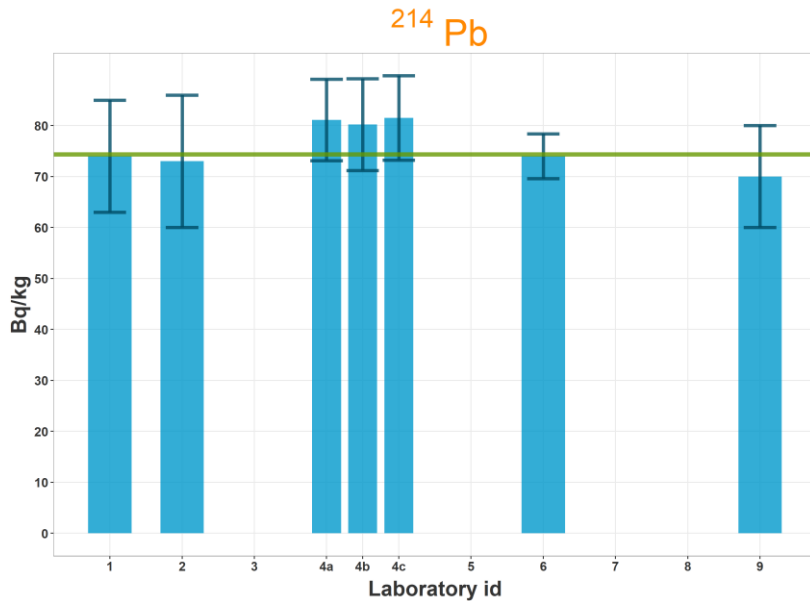
Average without outliers:

79 Bq/kg

**Lab 8 detected Ra-226, but regular methods require larger samples.

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for



Reported by 5 labs.

Min: 70 ± 10 Bq/kg

Max: $81,5 \pm 8,3$ Bq/kg

Average: 76 Bq/kg

Reported by 3 labs.

Min: 69 ± 4 Bq/kg

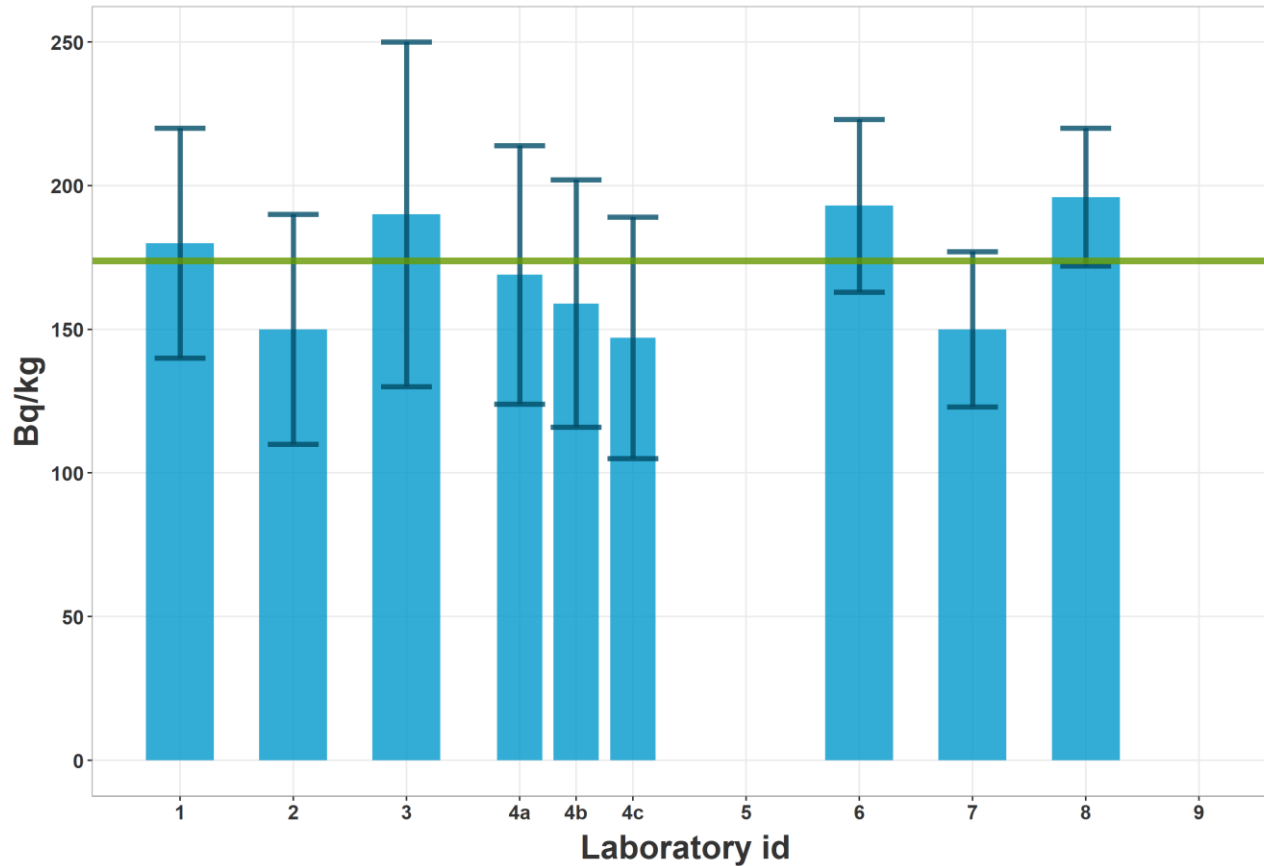
Max: 72 ± 12 Bq/kg

Average: 70 Bq/kg

*Results: Activity \pm Unc (k=2) [Bq/kg]

Reported results and their uncertainties for

²¹⁰Pb



Reported by 7 labs.

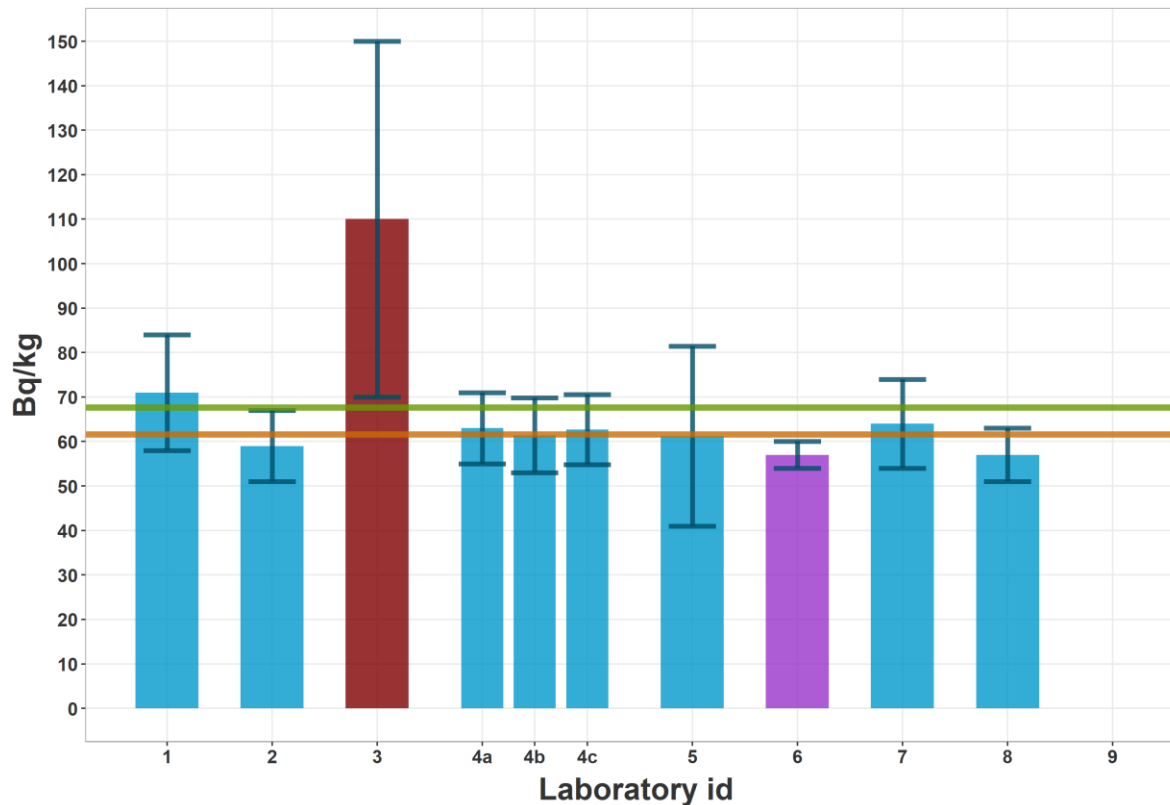
Min: 147 ± 42 Bq/kg
Max: 196 ± 24 Bq/kg

Average:
170 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for

^{228}Ra (from ^{228}Ac)



Reported by 8 labs.

Min: 57 ± 6 Bq/kg

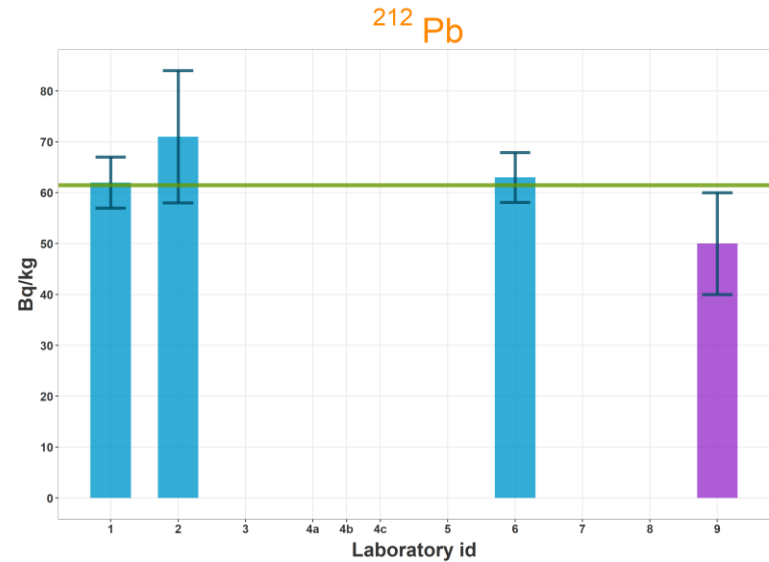
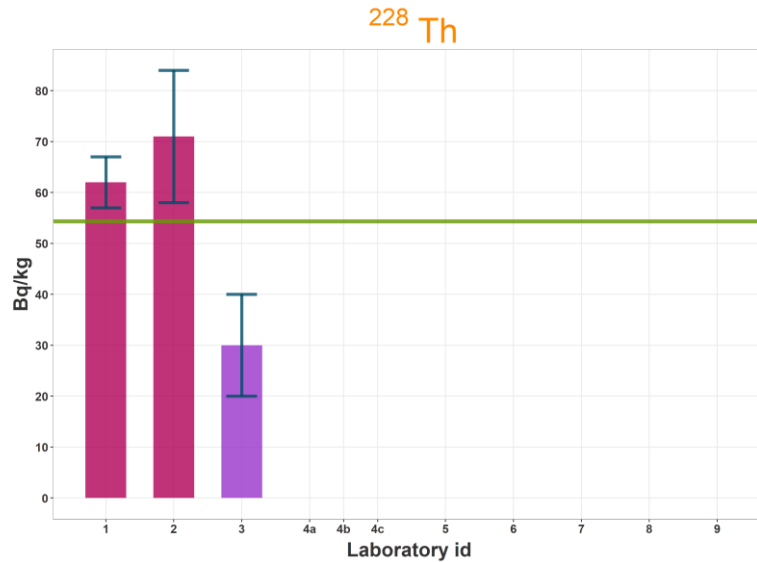
Max: 110 ± 40 Bq/kg

Average:
67 Bq/kg

Average without
outliers:
61,8 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for



Reported by 3 labs.

Min: 30 ± 10 Bq/kg
Max: 71 ± 13 Bq/kg

Average: 54 Bq/kg
Average of 1 and 2: 67 Bq/kg

Reported by 4 labs.

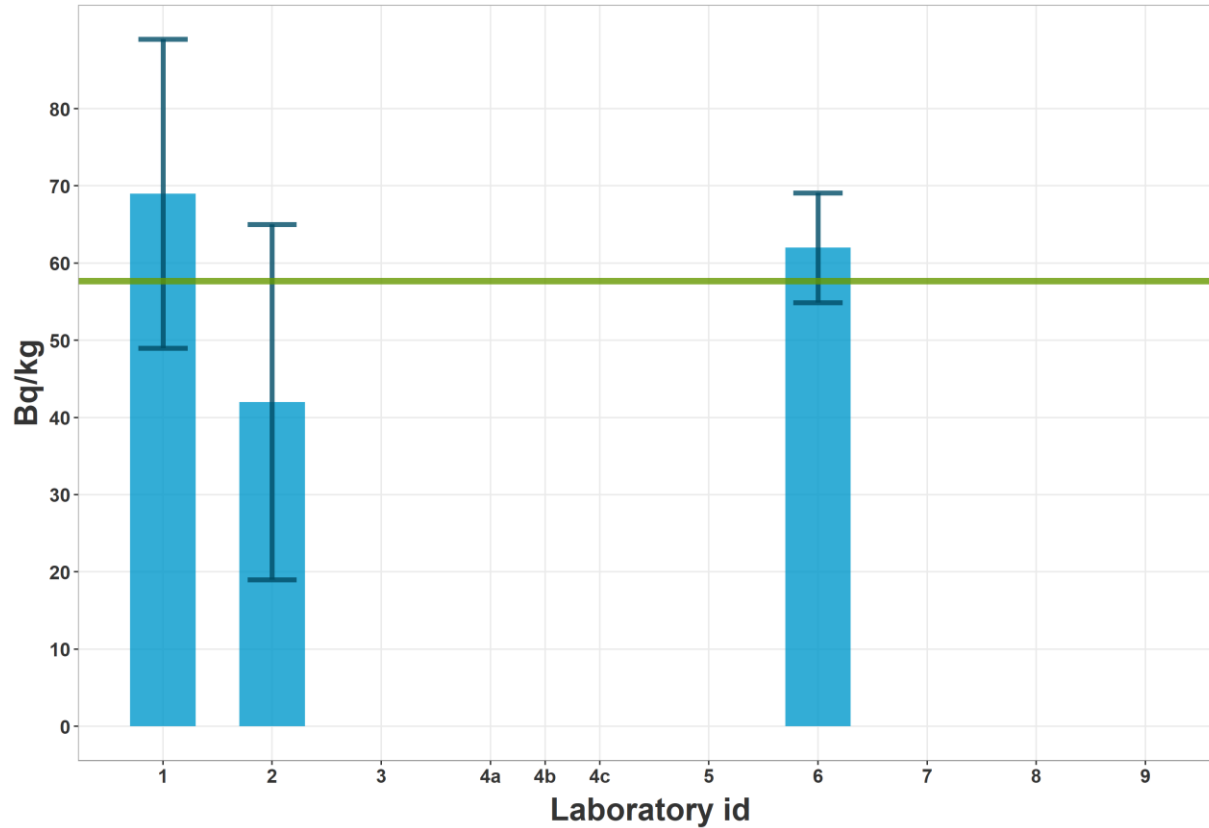
Min: 50 ± 10 Bq/kg
Max: 71 ± 13 Bq/kg

Average: 62 ± 8 Bq/kg

**Results: Activity \pm Unc (k=2) [Bq/kg]*

Reported results and their uncertainties for

²¹²Bi



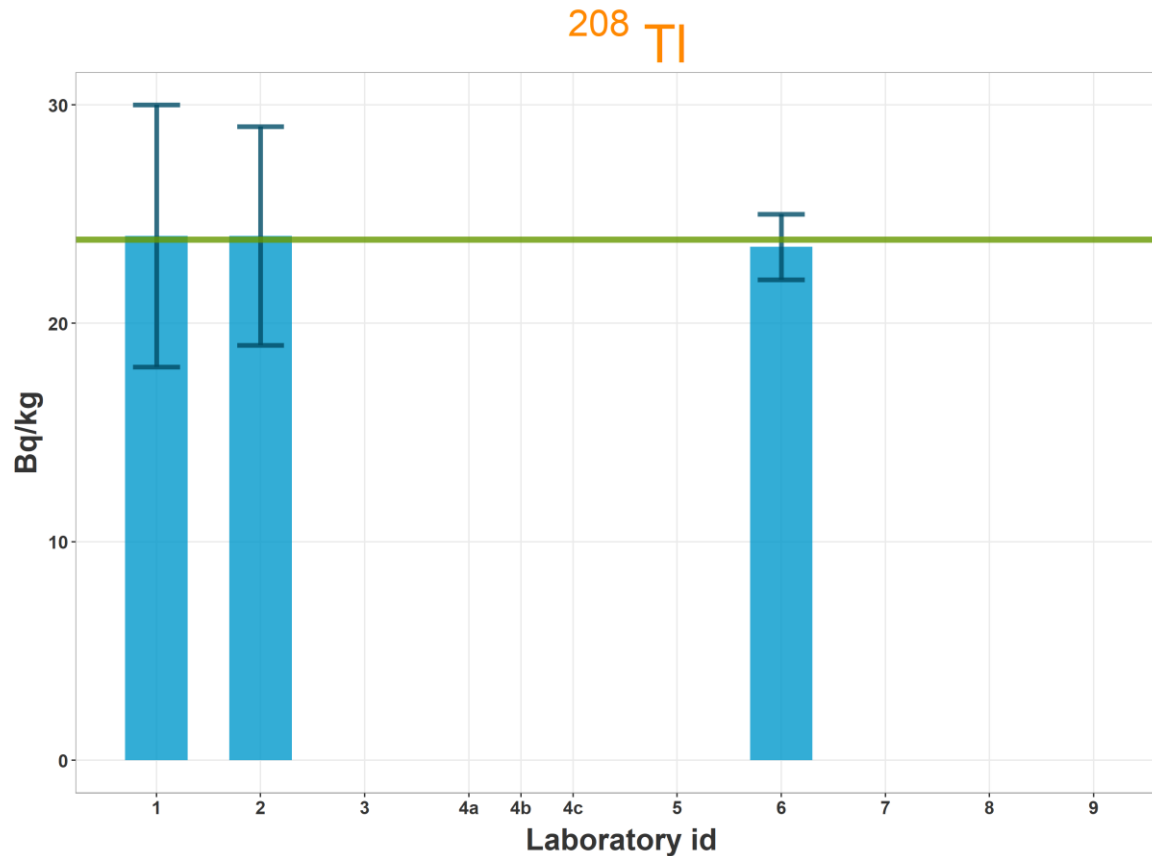
Reported by 3 labs.

Min: 42 ± 23 Bq/kg
Max: 69 ± 20 Bq/kg

Average:
58 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for



Reported by 3 labs.

Min: $23,5 \pm 1,5$ Bq/kg

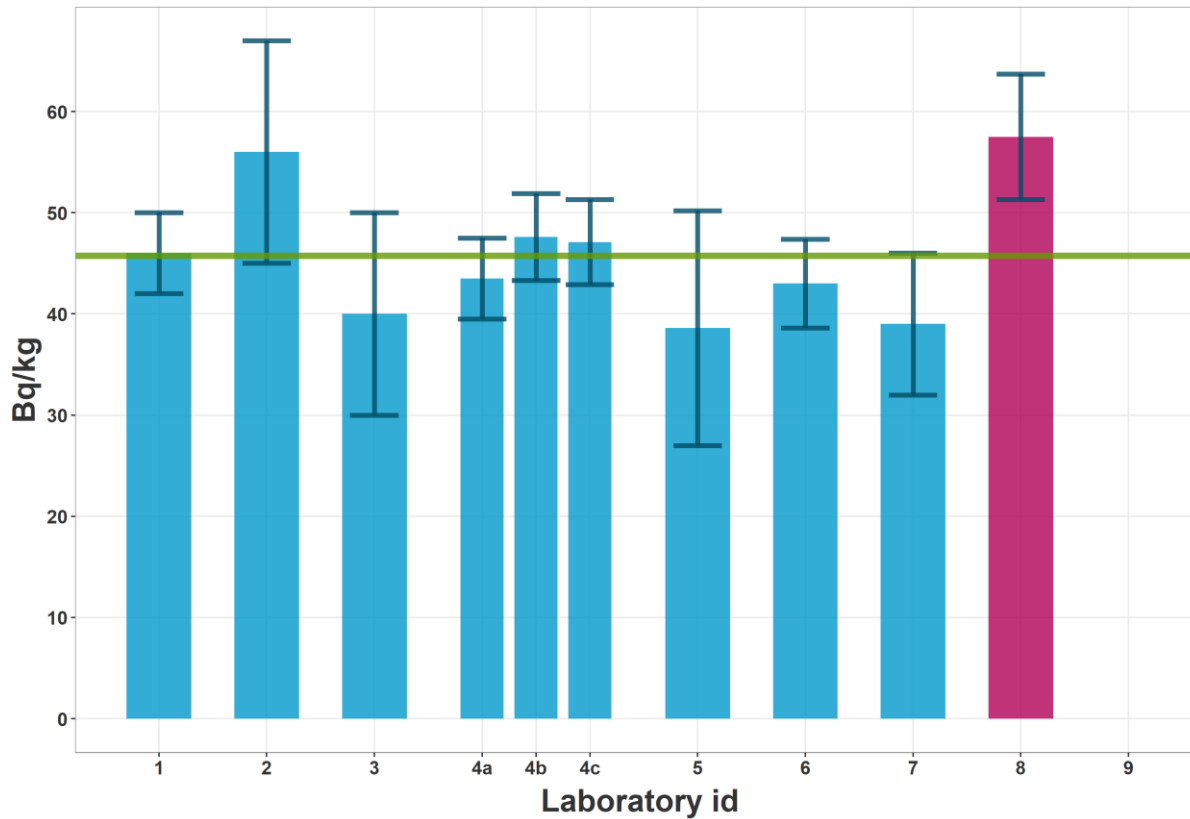
Max: 24 ± 6 Bq/kg

Average: 24 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for

²⁴¹Am



Reported by 8 labs.

Min: $38,6 \pm 11,6$ Bq/kg

Max: $57,5 \pm 6,2$ Bq/kg

Average:

46 Bq/kg

*Results: Activity \pm Unc ($k=2$) [Bq/kg]

Reported results and their uncertainties for

^{235}U : $11,5 \pm 2,3$ Bq/kg (Lab. no . 6)

^{154}Eu : $4,7 \pm 1,2$ Bq/kg (Lab. no . 7)

**Results: Activity \pm Unc (k=2) [Bq/kg]*

Thank you for your attention