GL and GH samples

NPL Environmental Radioactivity Proficiency Test Exercise 2007 Workshop

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19 September 2007

- 10 nuclides:

  ^{60}Co, ^{95}Zr, ^{95}Nb, ^{125}Sb, ^{133}Ba, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{152}Eu and ^{155}Eu

- Two concentration levels:

  | GL | $1 - 20$ Bq kg^{-1} |
  | GH | $1 - 20$ Bq g^{-1} |

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GL and GH composition

	GL (Bq kg^{-1})	GH (Bq g^{-1})
^{60}Co	11.72(4)	16.32(5)
^{95}Zr	4.21(5)	6.82(8)
^{95}Nb	7.38(12)	11.94(19)
^{125}Sb	13.43(7)	17.23(8)
^{133}Ba	4.15(3)	4.07(3)
^{134}Cs	4.07(3)	1.160(8)
^{137}Cs	8.84(6)	3.68(3)
^{144}Ce	14.80(10)	7.50(6)
^{152}Eu	17.91(12)	18.99(14)
^{155}Eu	6.18(5)	4.07(3)

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Treatment of data

(i)   Zeta test
      pass if Abs(zeta) $\leq$ 2.58

$$\zeta = \frac{L - N}{\sqrt{u_L^2 + u_N^2}}$$

(ii) R_L outlier test
      pass if not an Dixon outlier

$$R_L = \frac{u_L}{L}$$

(iii) z test
      pass if Abs(z test) $\leq$ 2.58

$$z = \frac{L - N}{R_{med} N}$$

R_{med} = median of participants relative uncertainties (generally between 5% and 10%)

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Zeta test	R_L test	z test	
pass	pass	pass	'In agreement'
pass	fail	pass	'Questionable' (a)
fail	pass/fail	pass	'Questionable' (b)
pass	pass/fail	fail	'Questionable' (c)
fail	pass/fail	fail	'Discrepant'

(a) Result close to NPL but unacceptable large uncertainty

(b) Result close to NPL but uncertainty is too small to pass zeta test

(c) Result not close to NPL but large uncertainty results in passing the zeta test

Deviation (%)
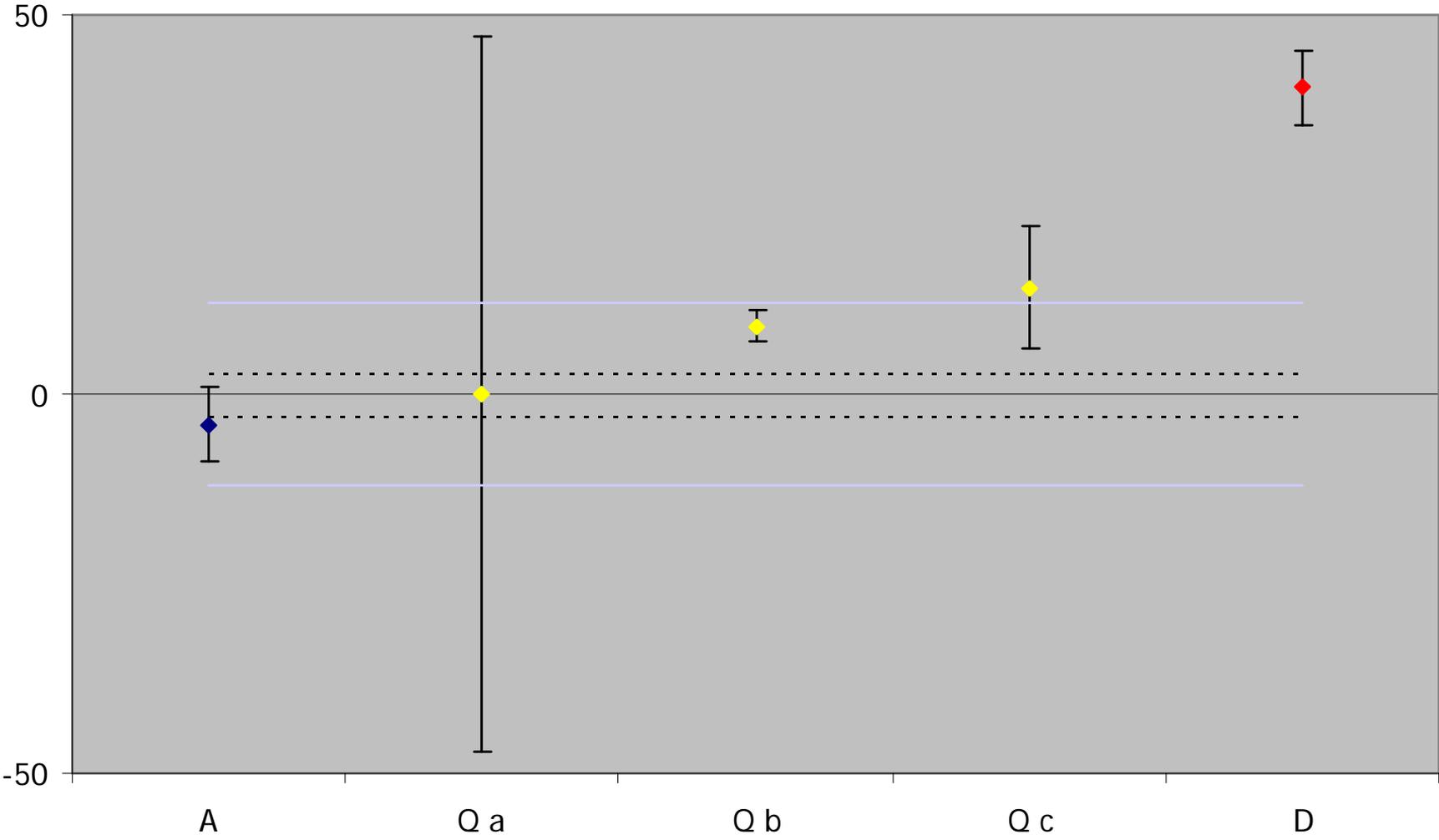
Deviation Co-60 GL (%)
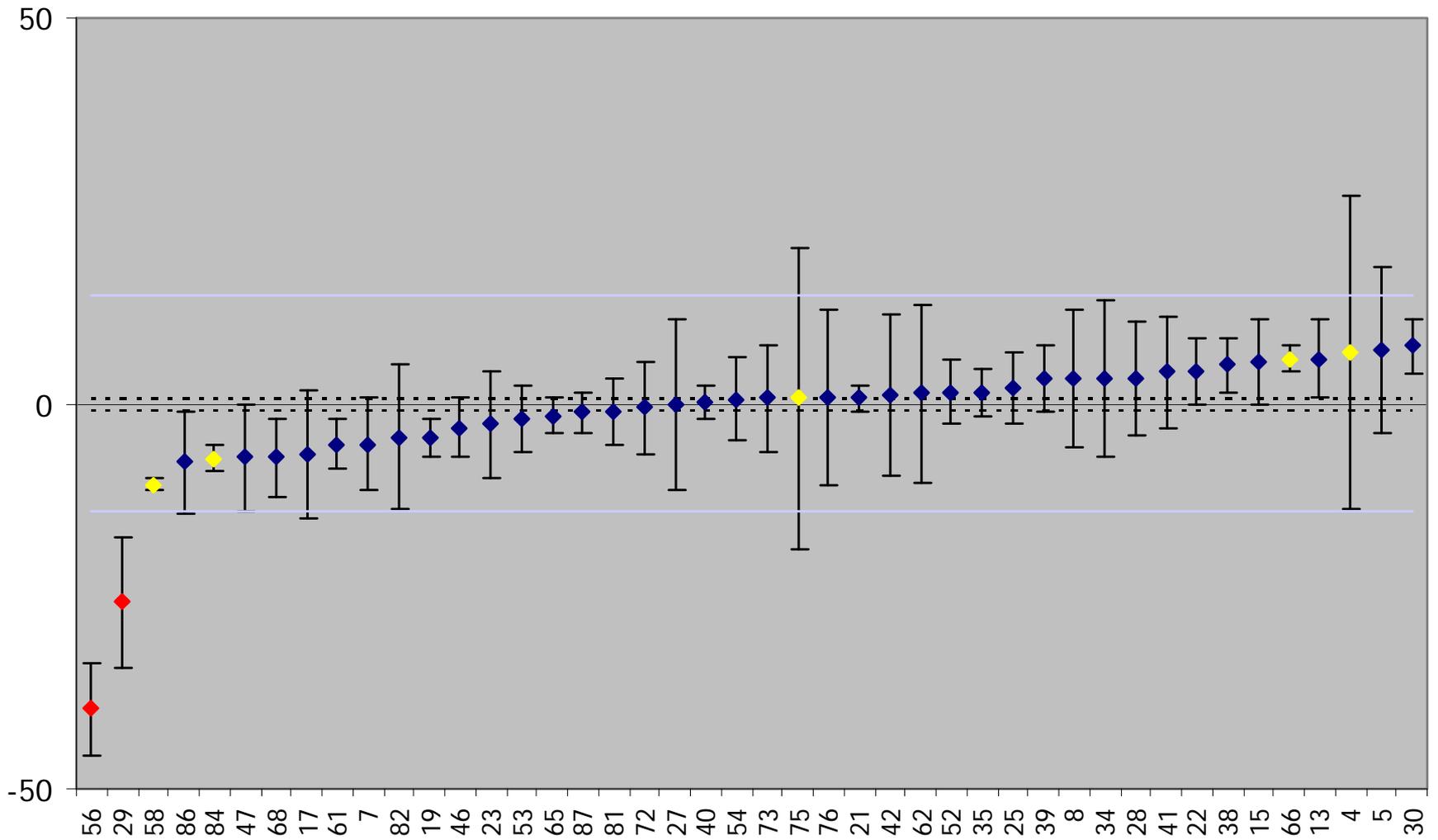
Deviation Co-60 GH (%)
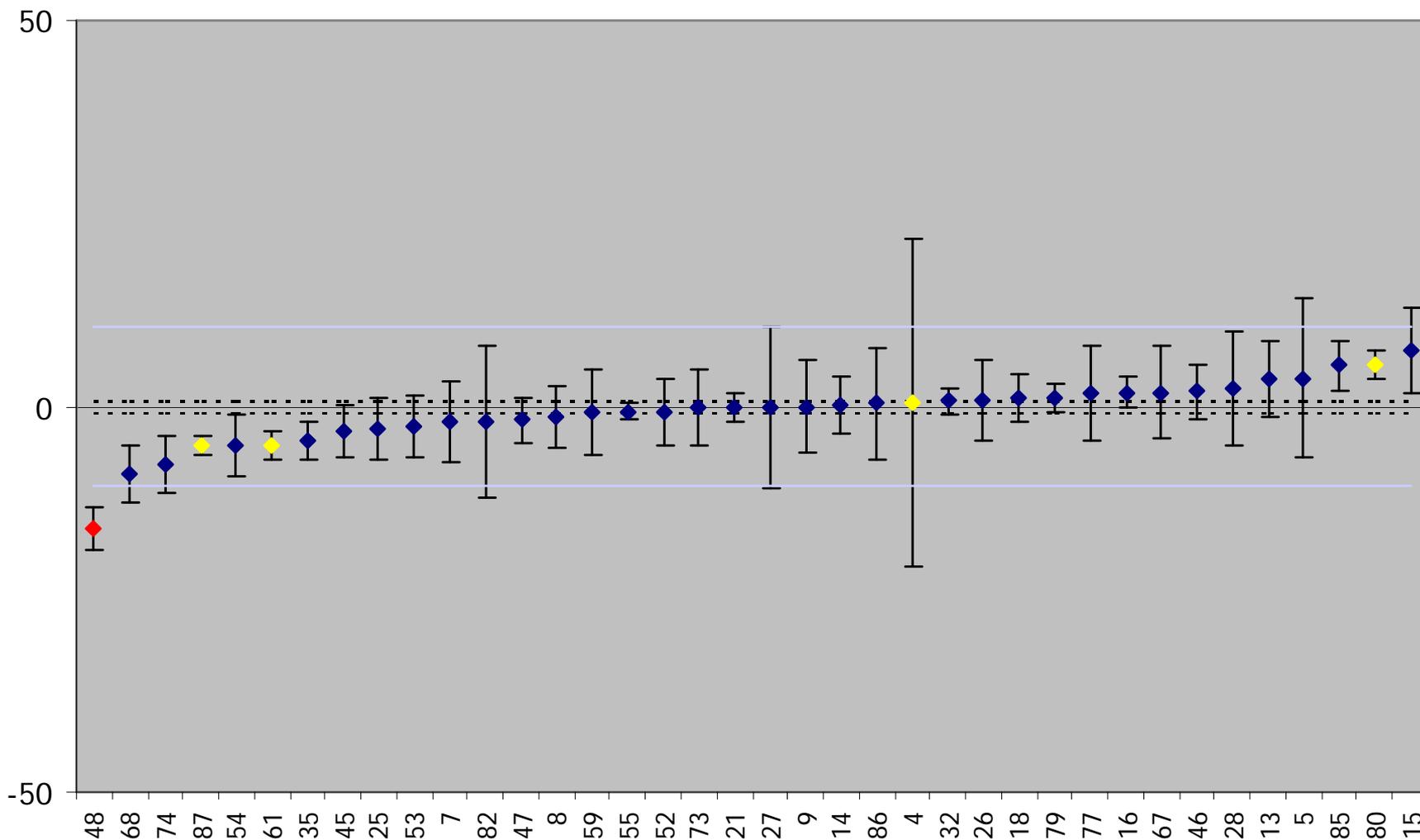
Deviation Zr-95 GL (%)
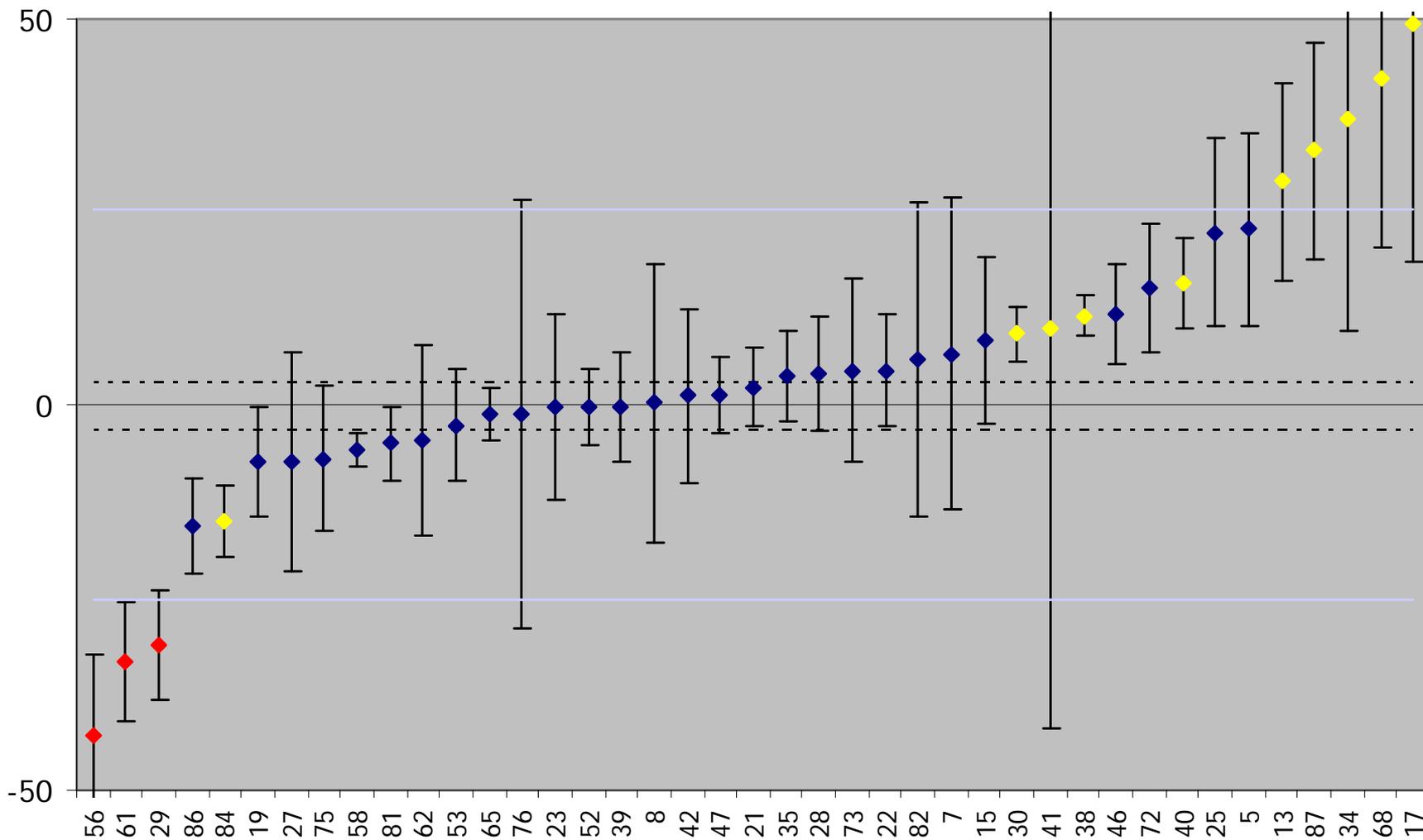
Deviation Zr-95 GH (%)
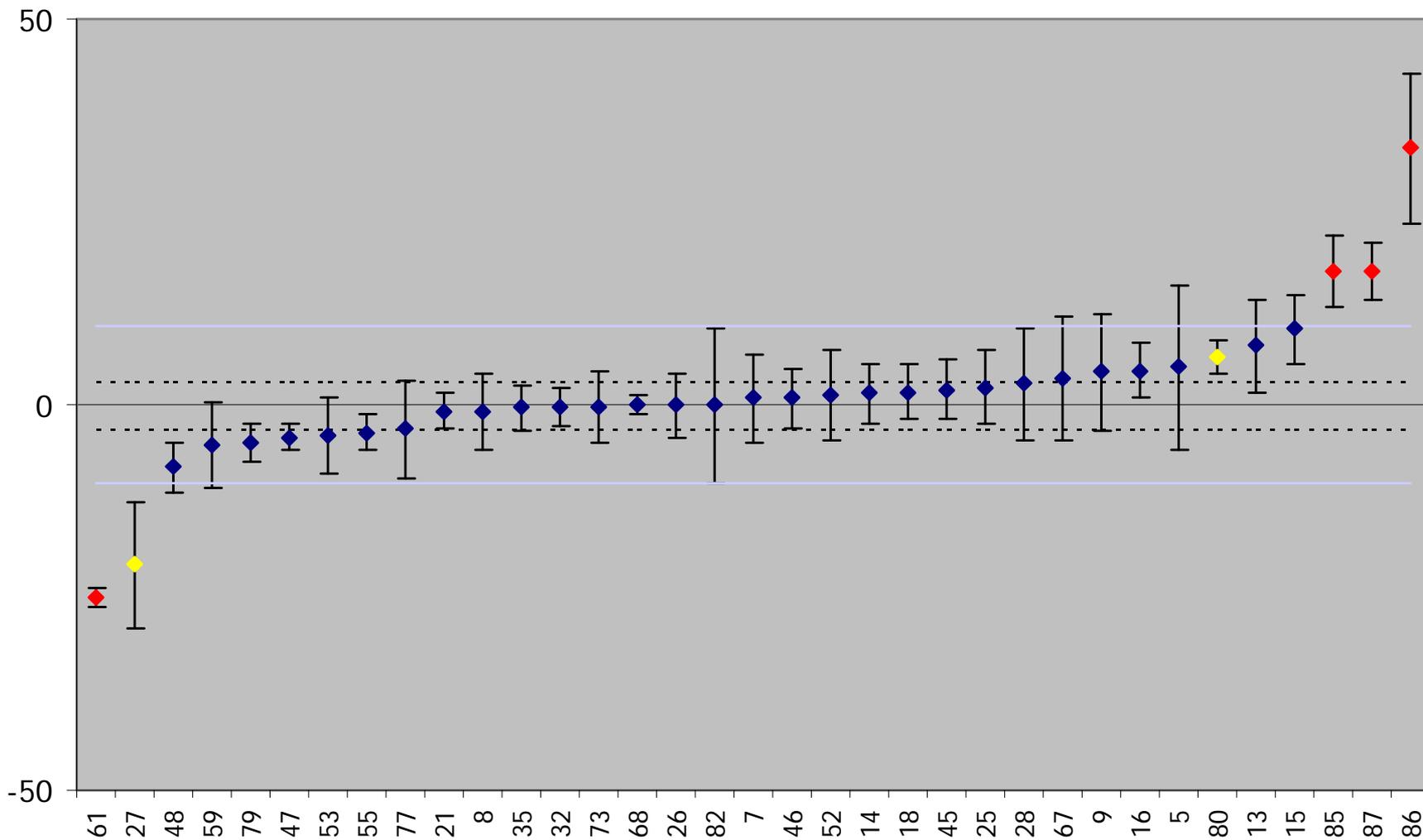
Deviation Nb-95 GL (%)
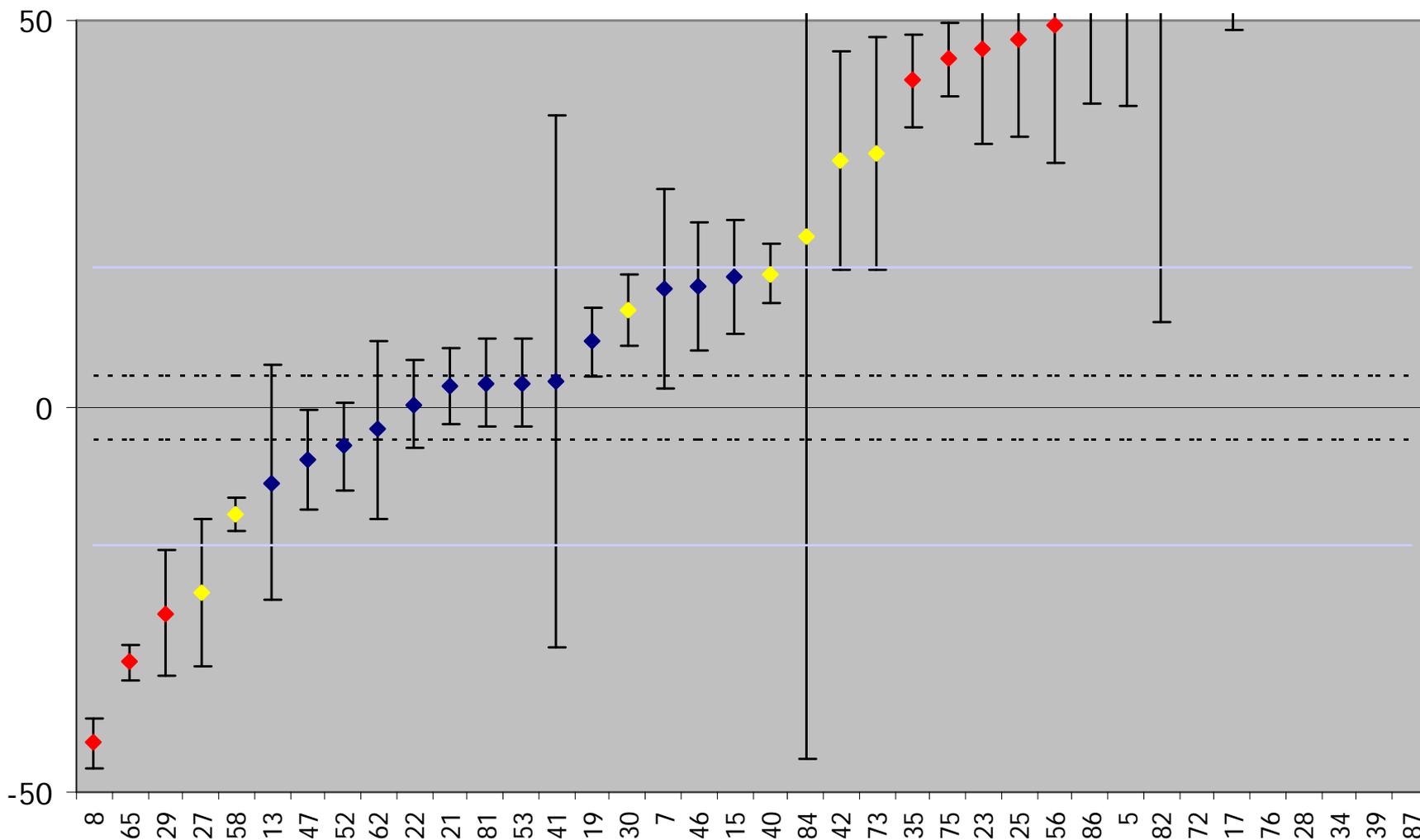
Deviation Nb-95 GL
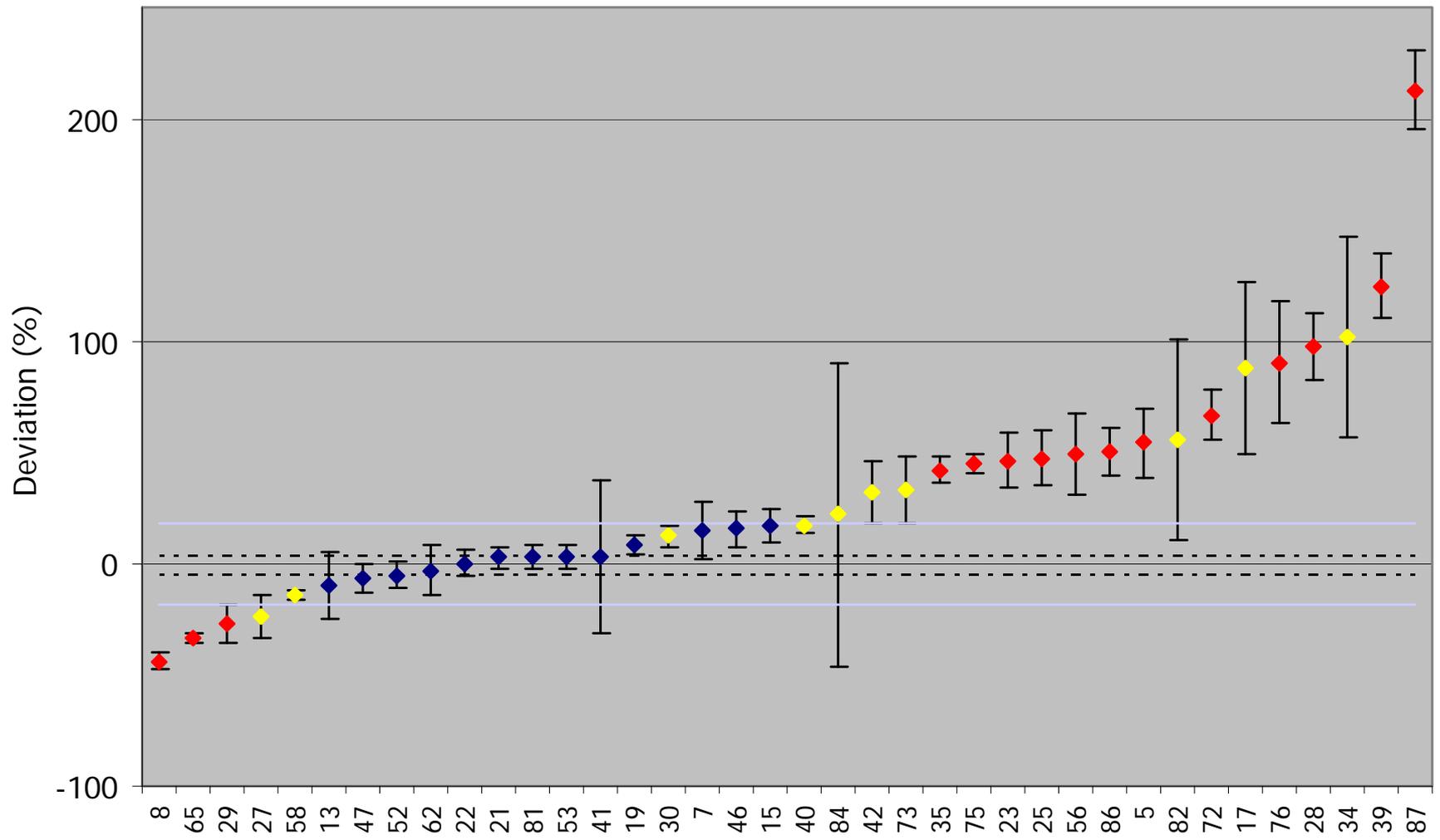
Nb-95 decay correction

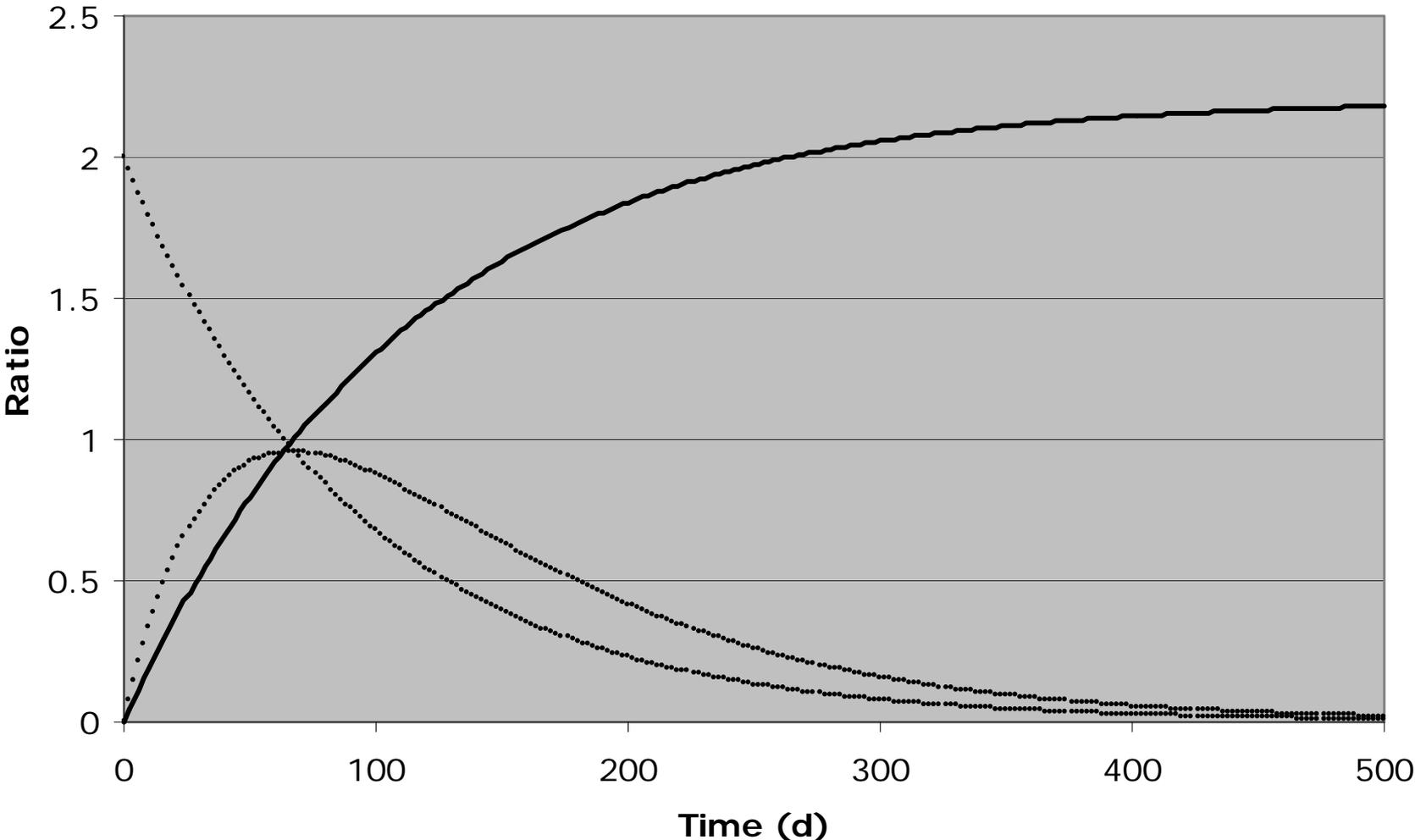Half-life Nb-95   =   34.991(6) d
Half-life Zr-95   =   64.032(6) d

At the reference time (1 April 2007 12:00 GMT), the Nb-95 / Zr-95 ratio was 1.752(15)

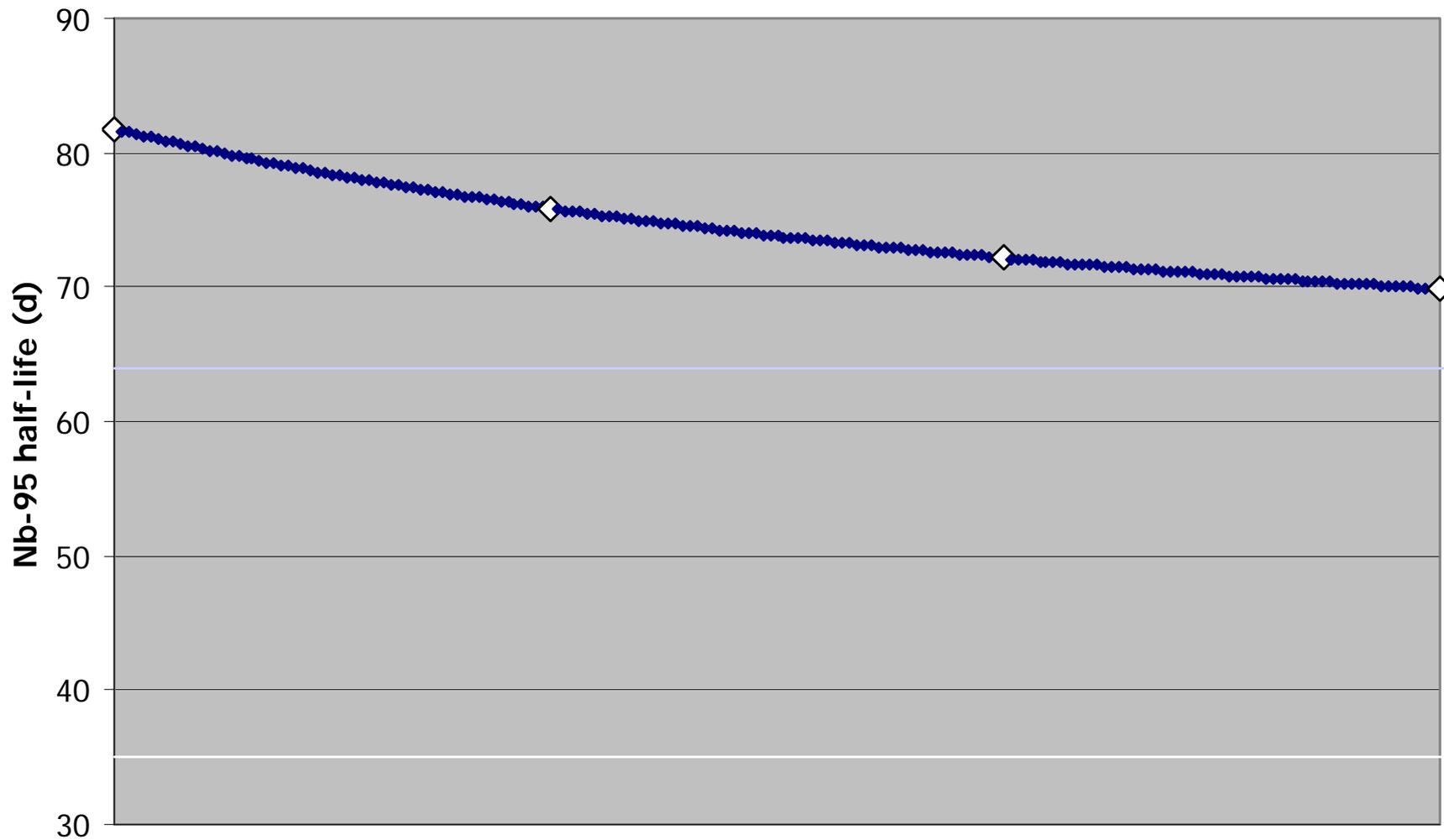The equilibrium value of this ratio is 2.206 (at this point Nb-95 decays with a Zr-95 half-life)

During the Exercise, Nb-95 decayed "slower" than Zr-95!

The "effective Nb-95 half-life" is a function of time

Nb-95 / Zr-95 ratio

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Nb-95 half-life between 1 April 2007 and 1 July 2007
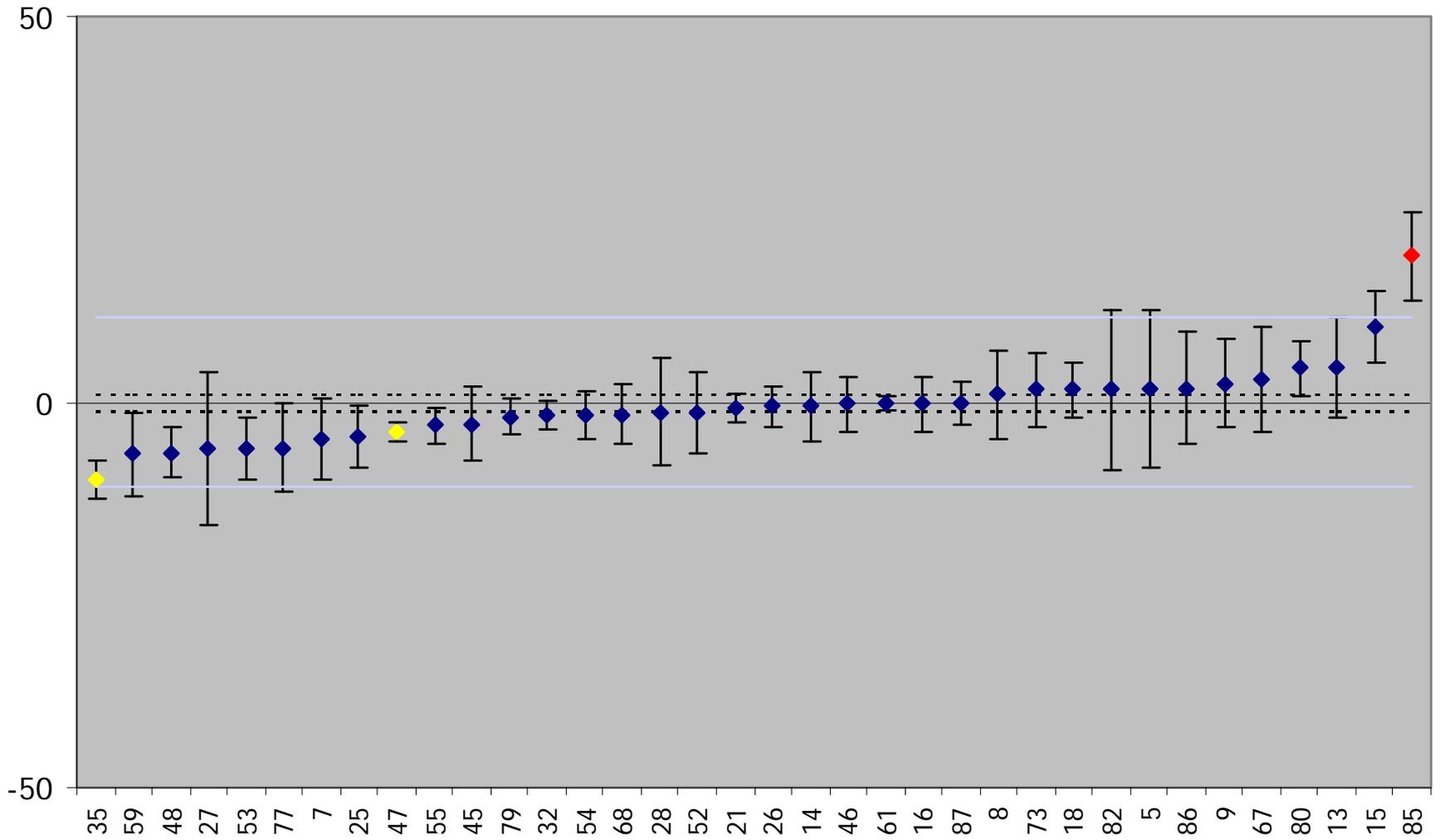
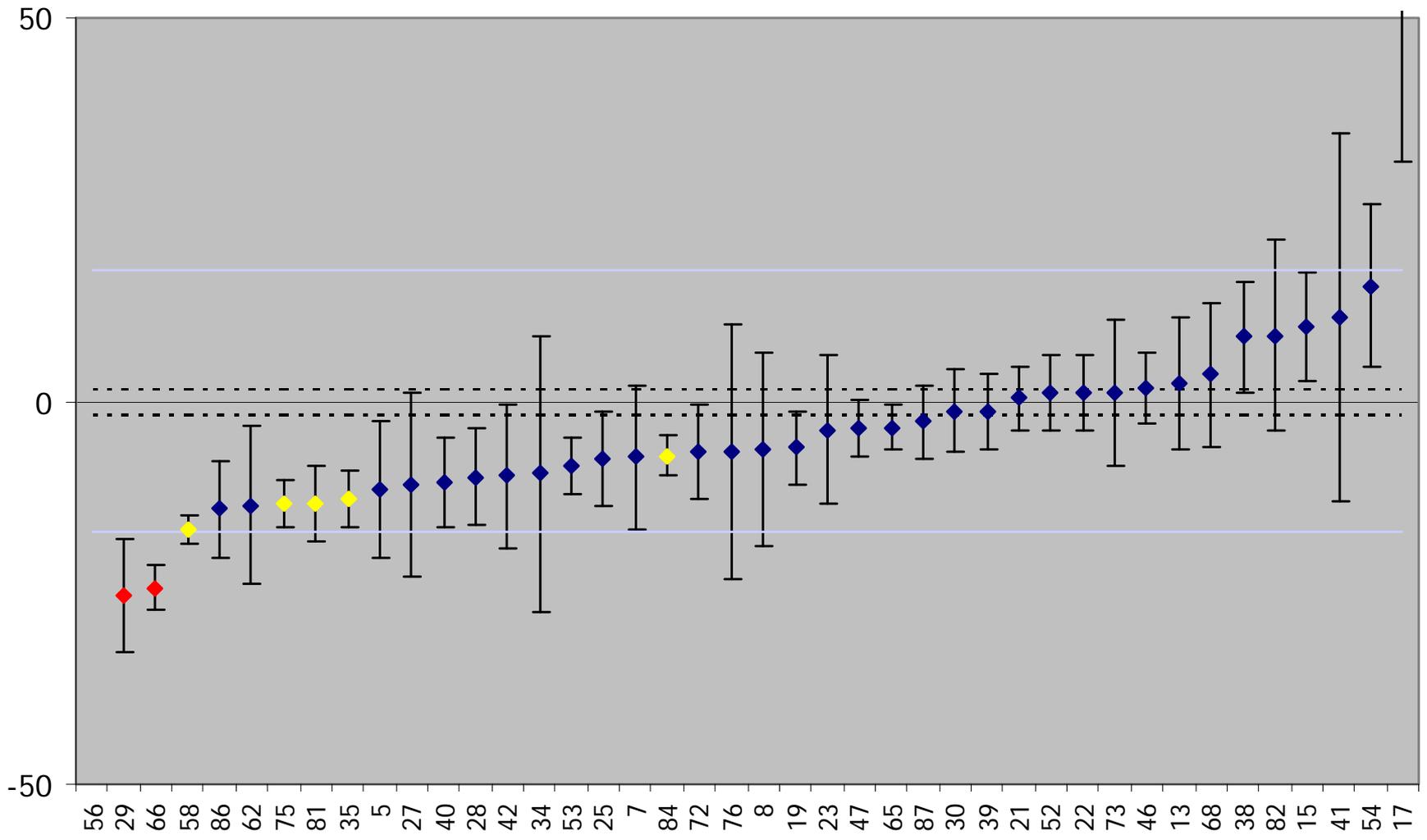Deviation Nb-95 GH (%)
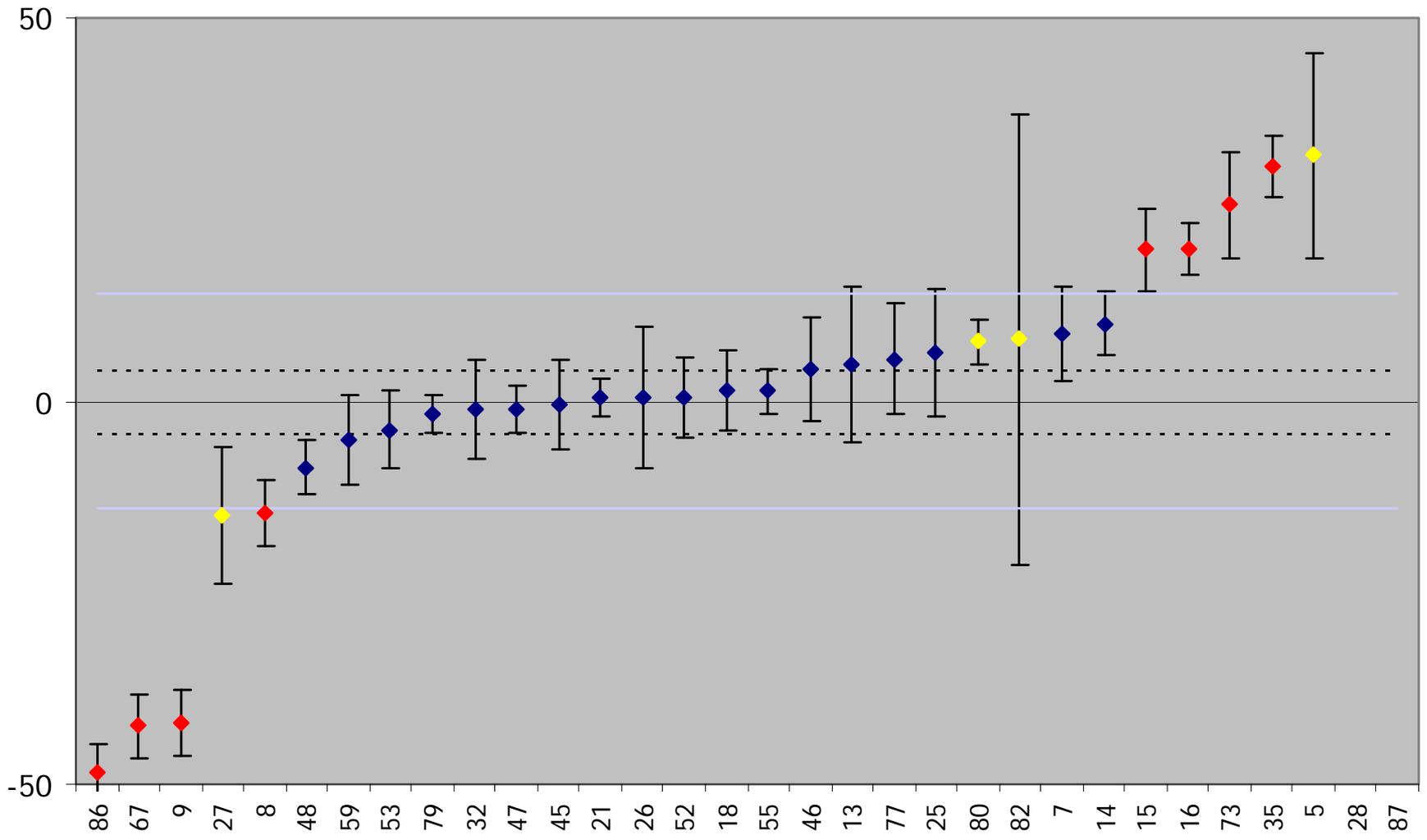
Kiri plot Nb-95 GH
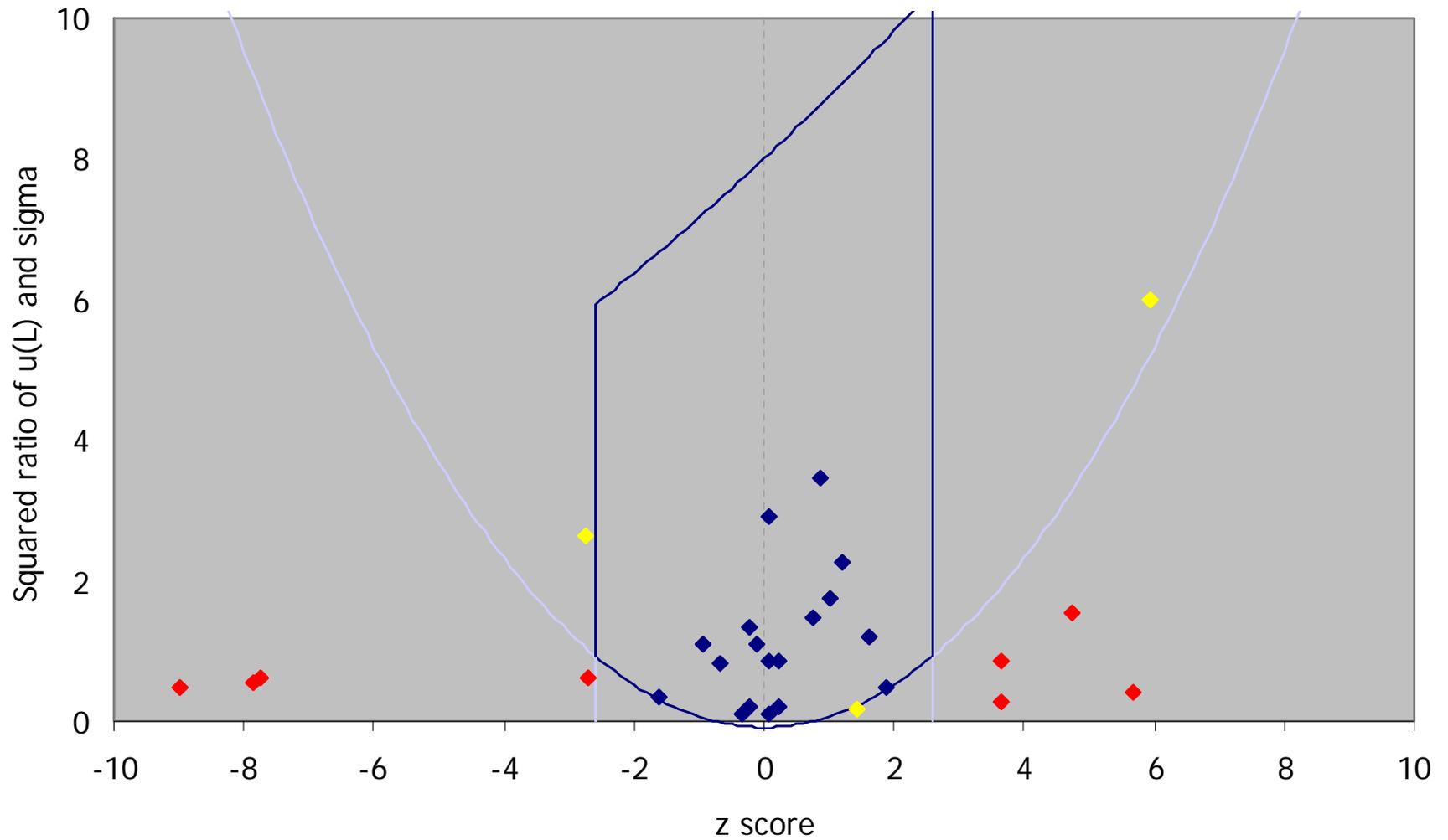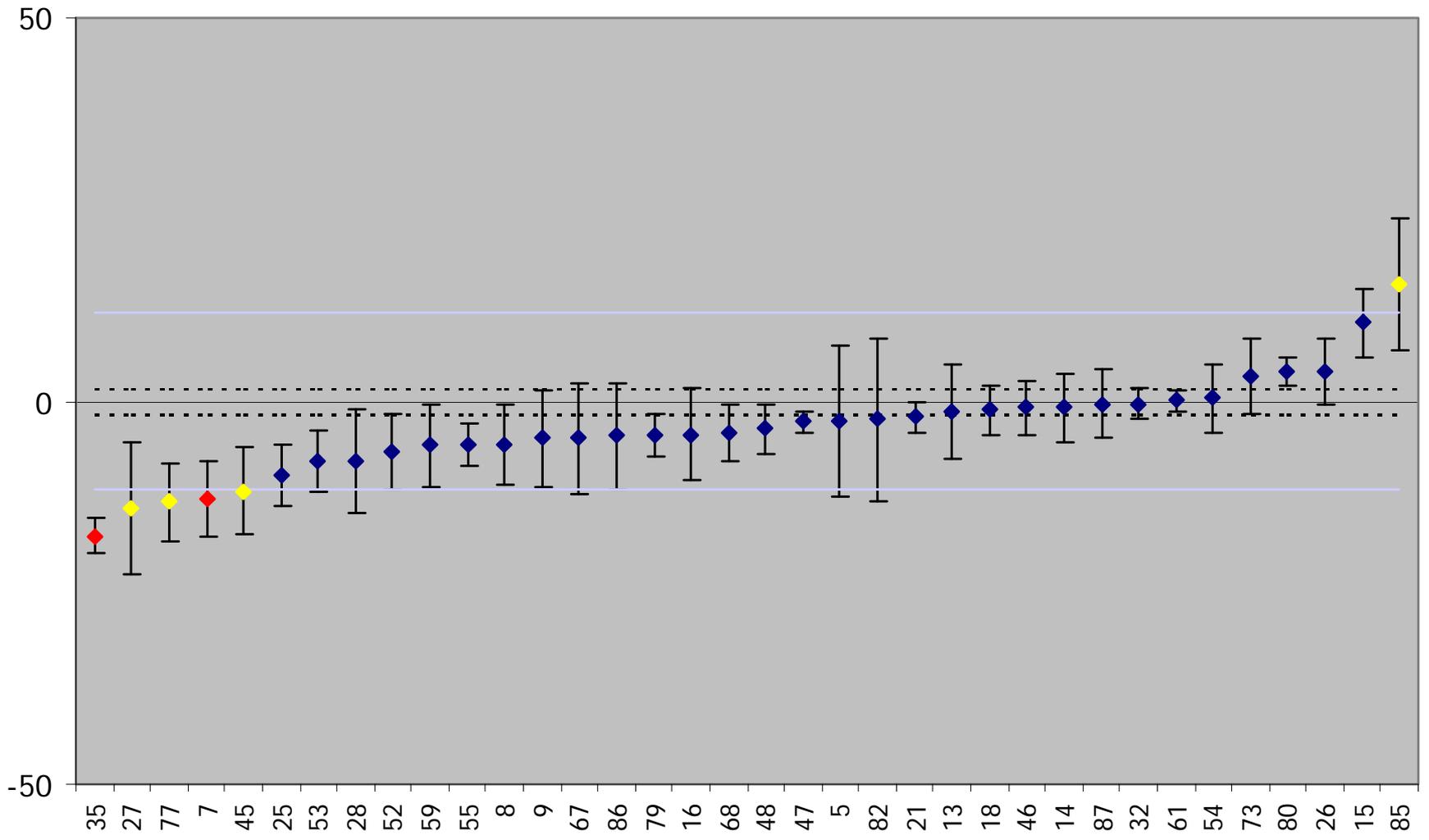
Kiri plot Nb-95 GH
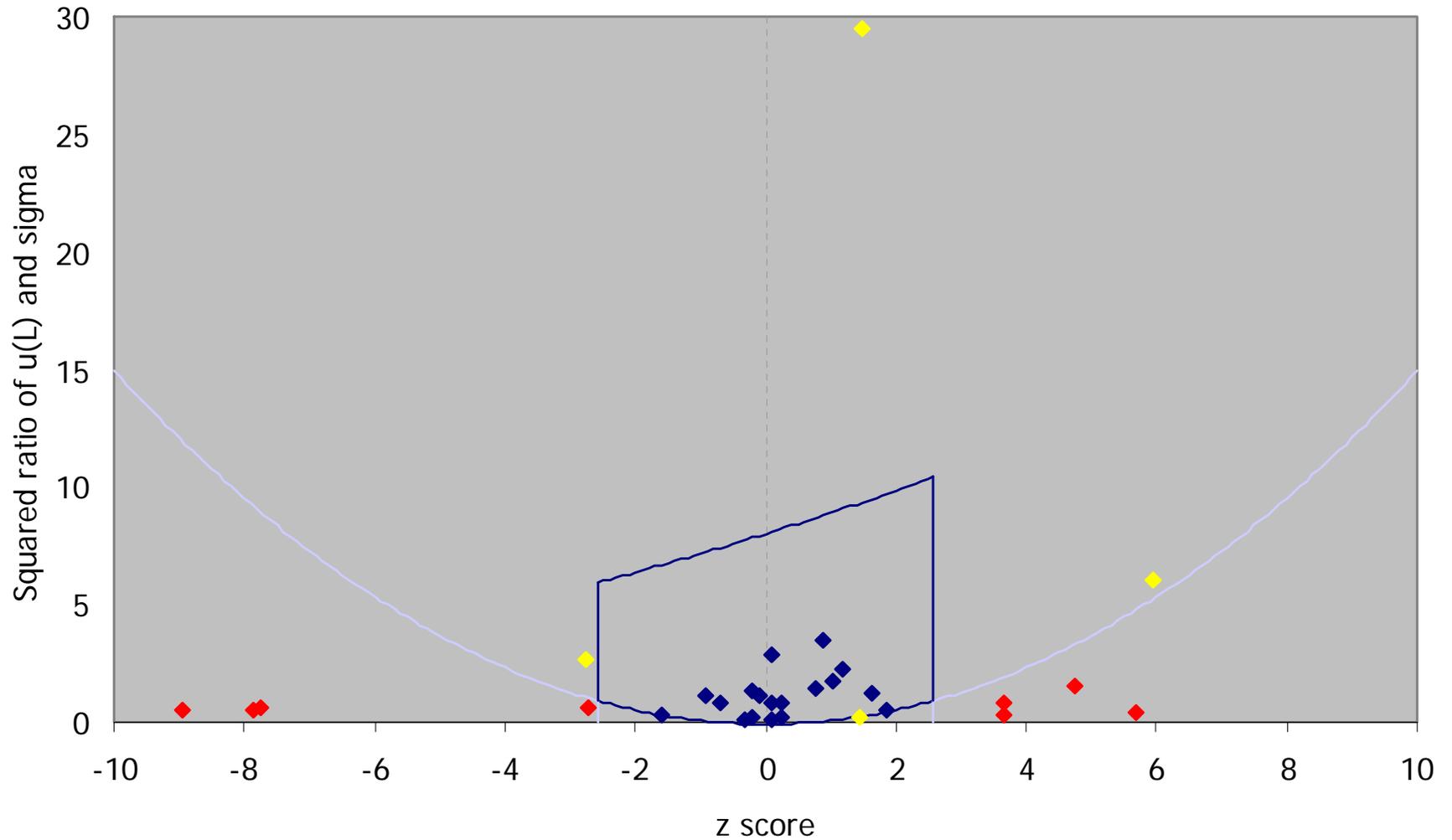
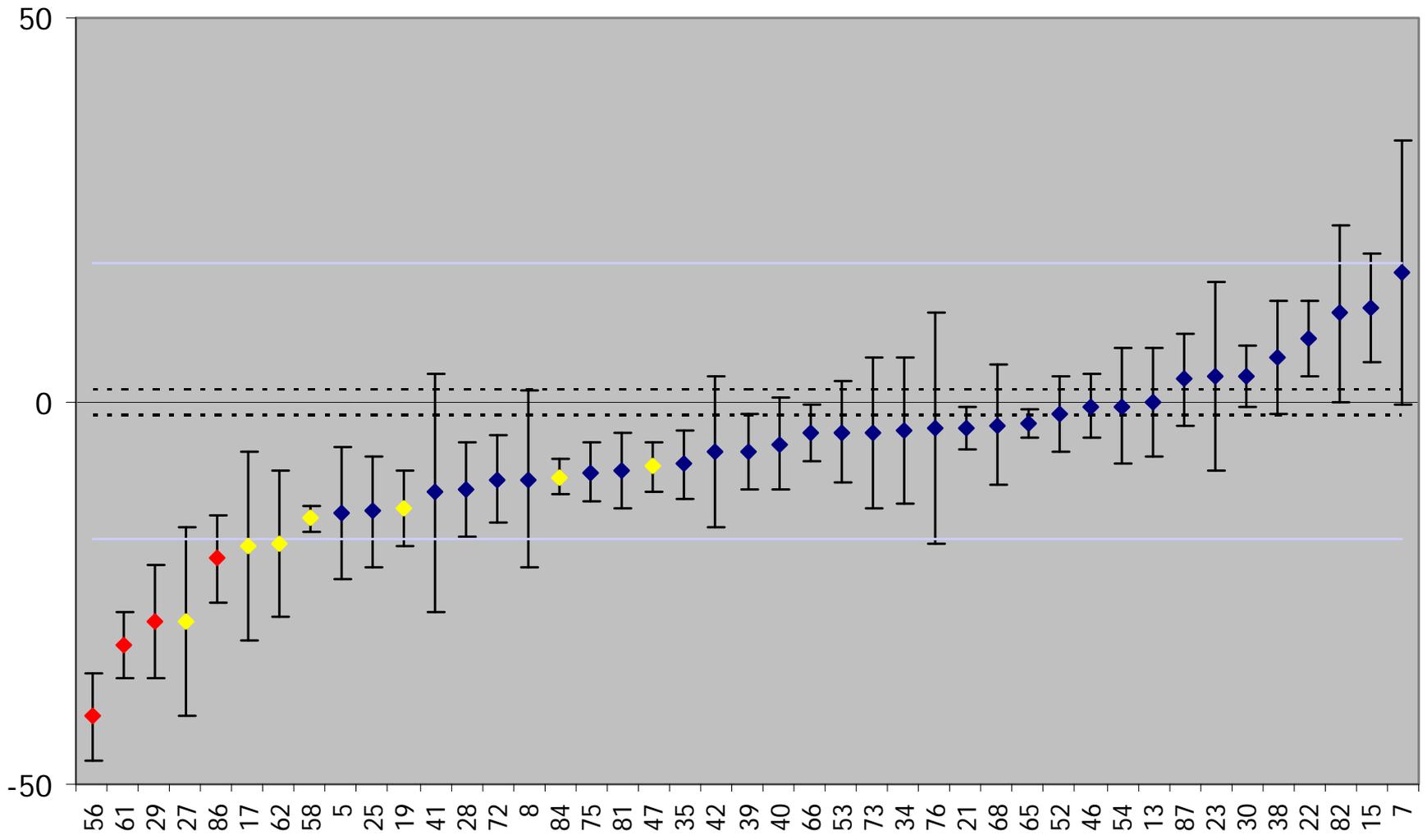Deviation Sb-125 GL (%)
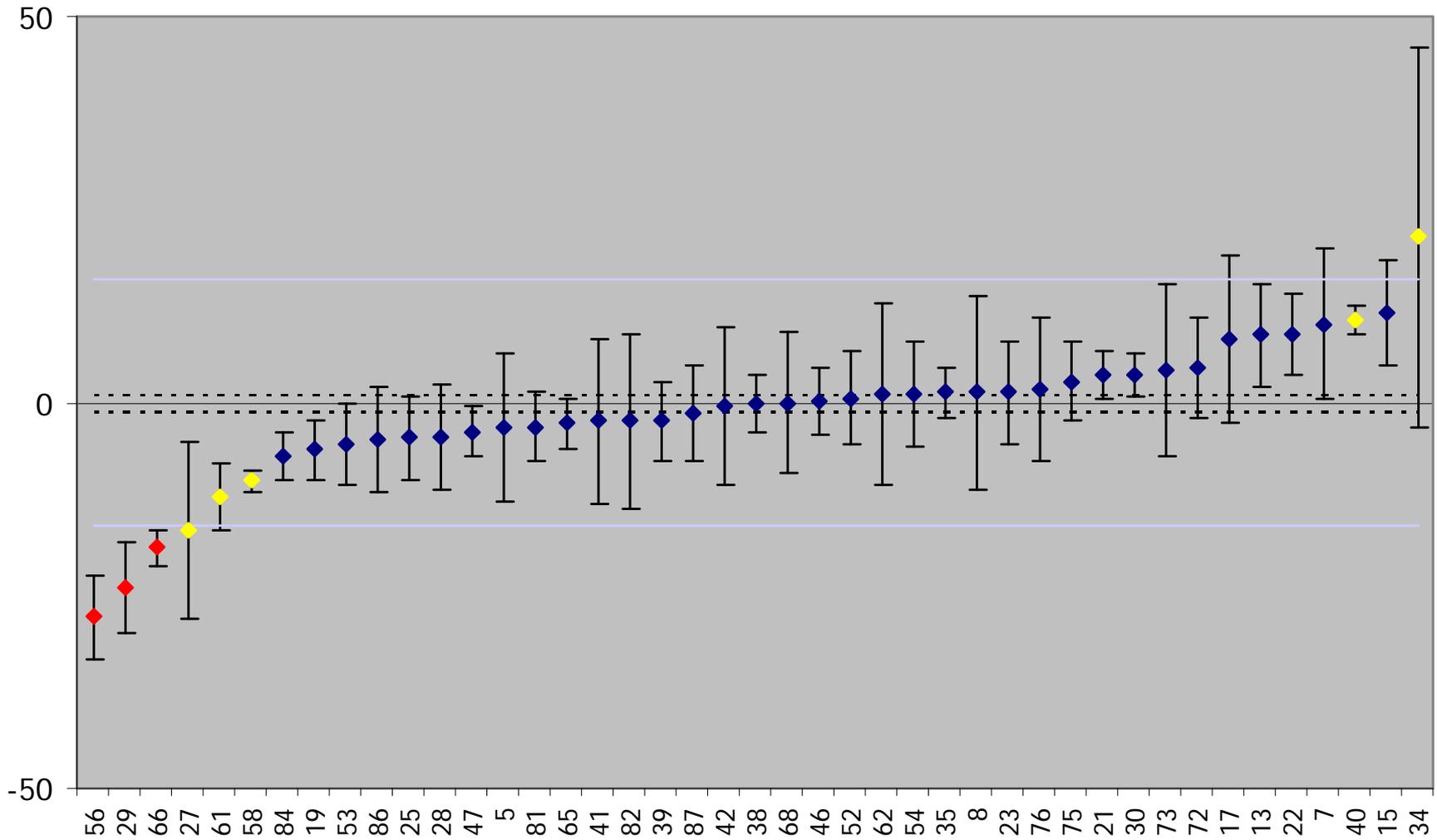
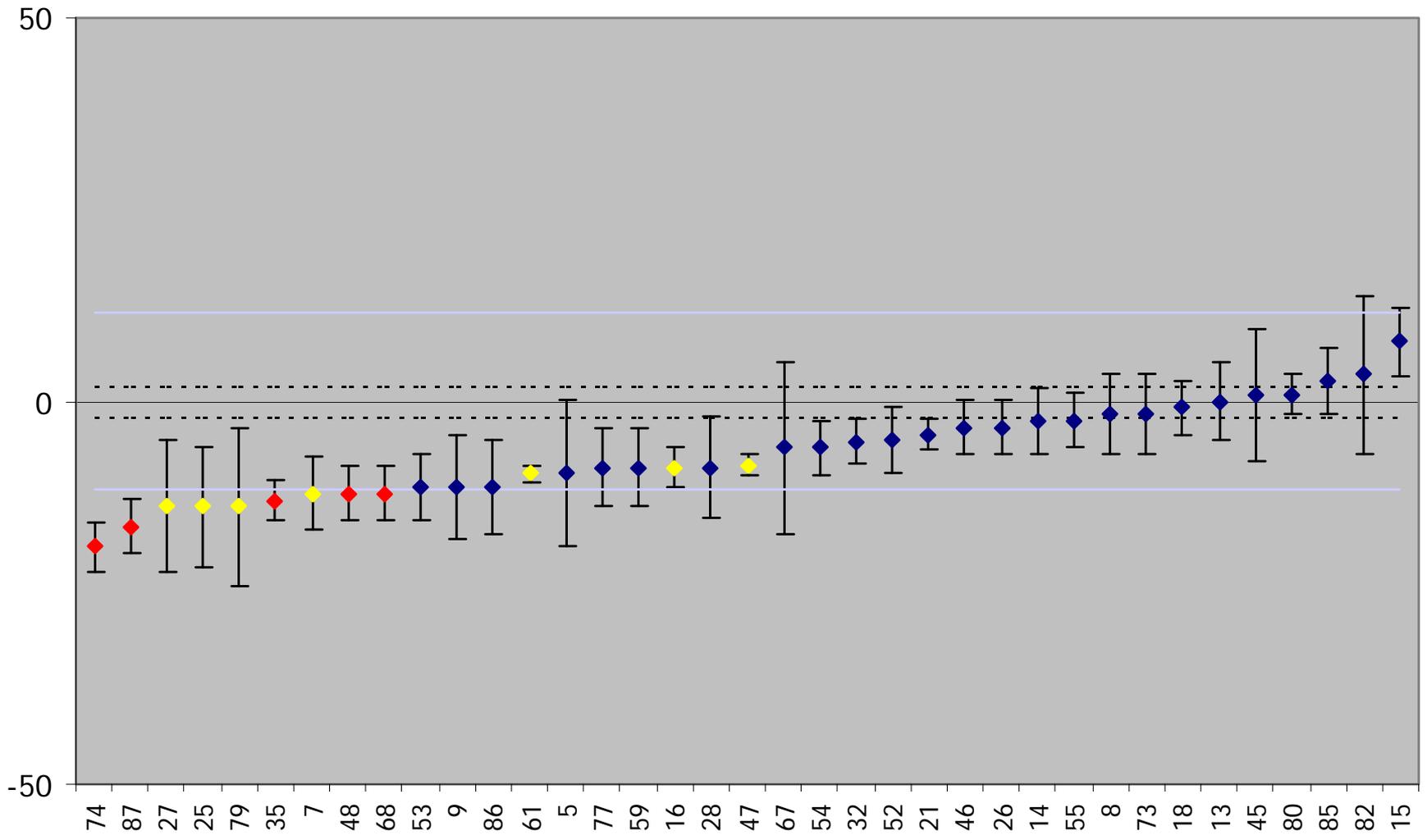Deviation Sb-125 GH (%)
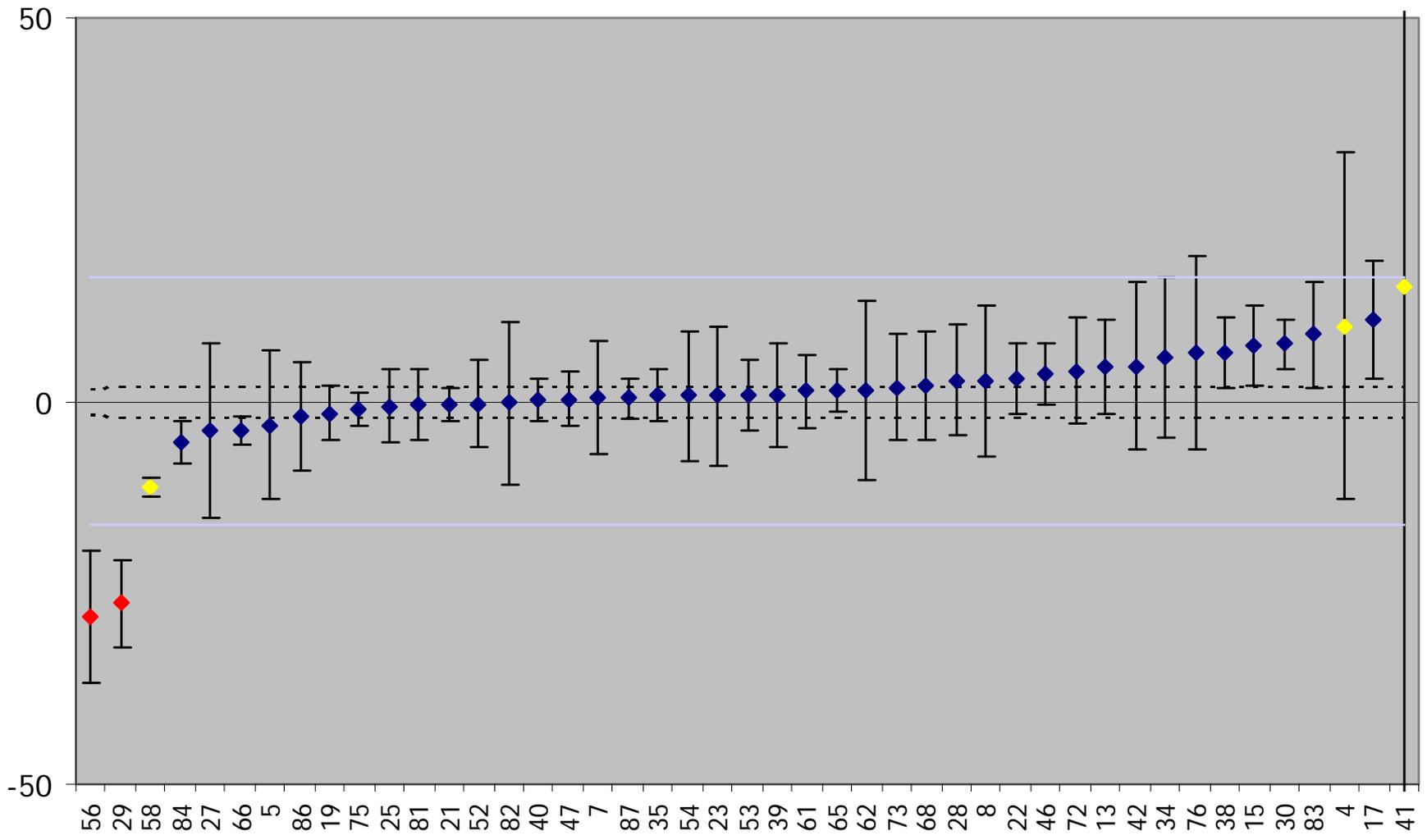
Deviation Ba-133 GL (%)

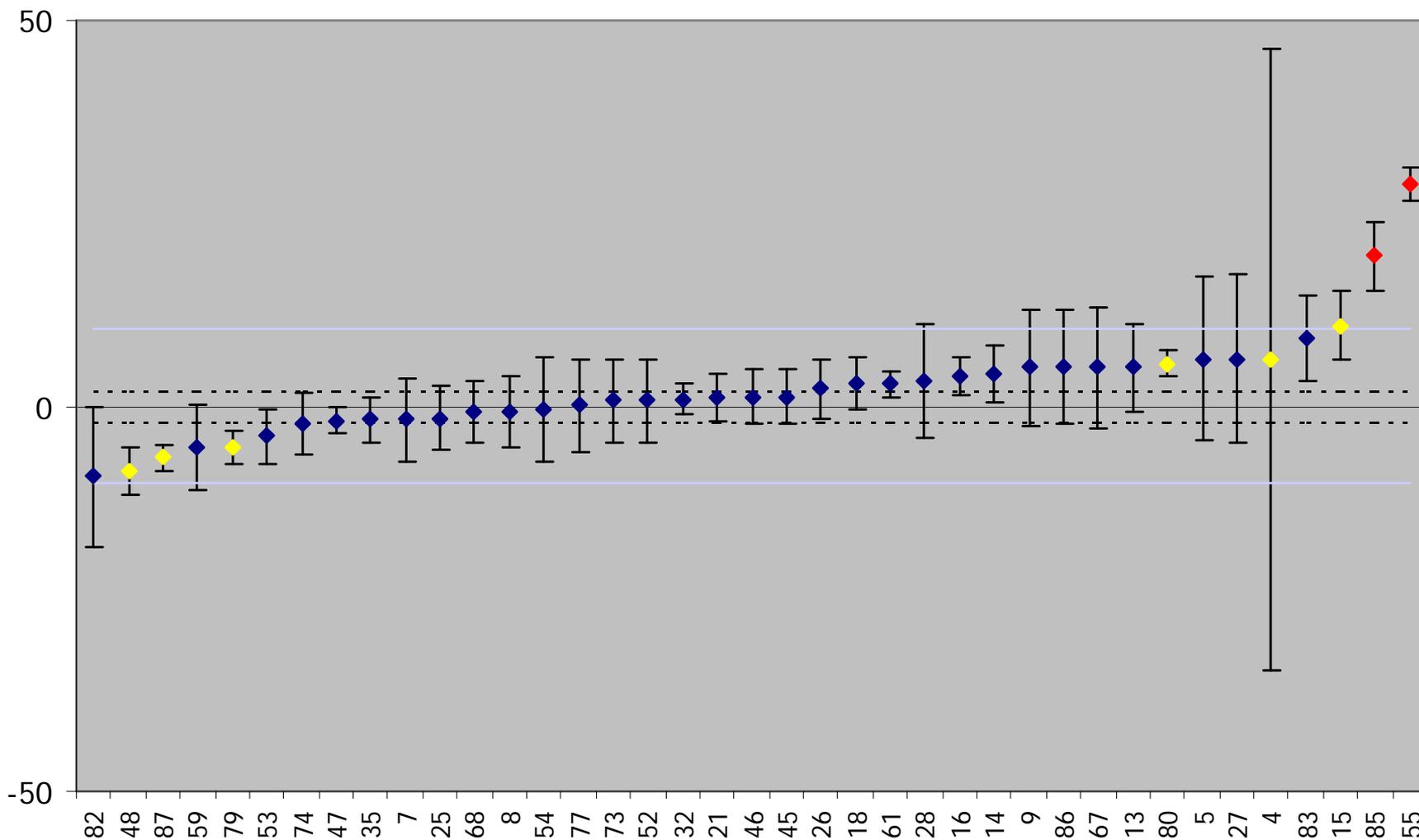Deviation Ba-133 GH (%)

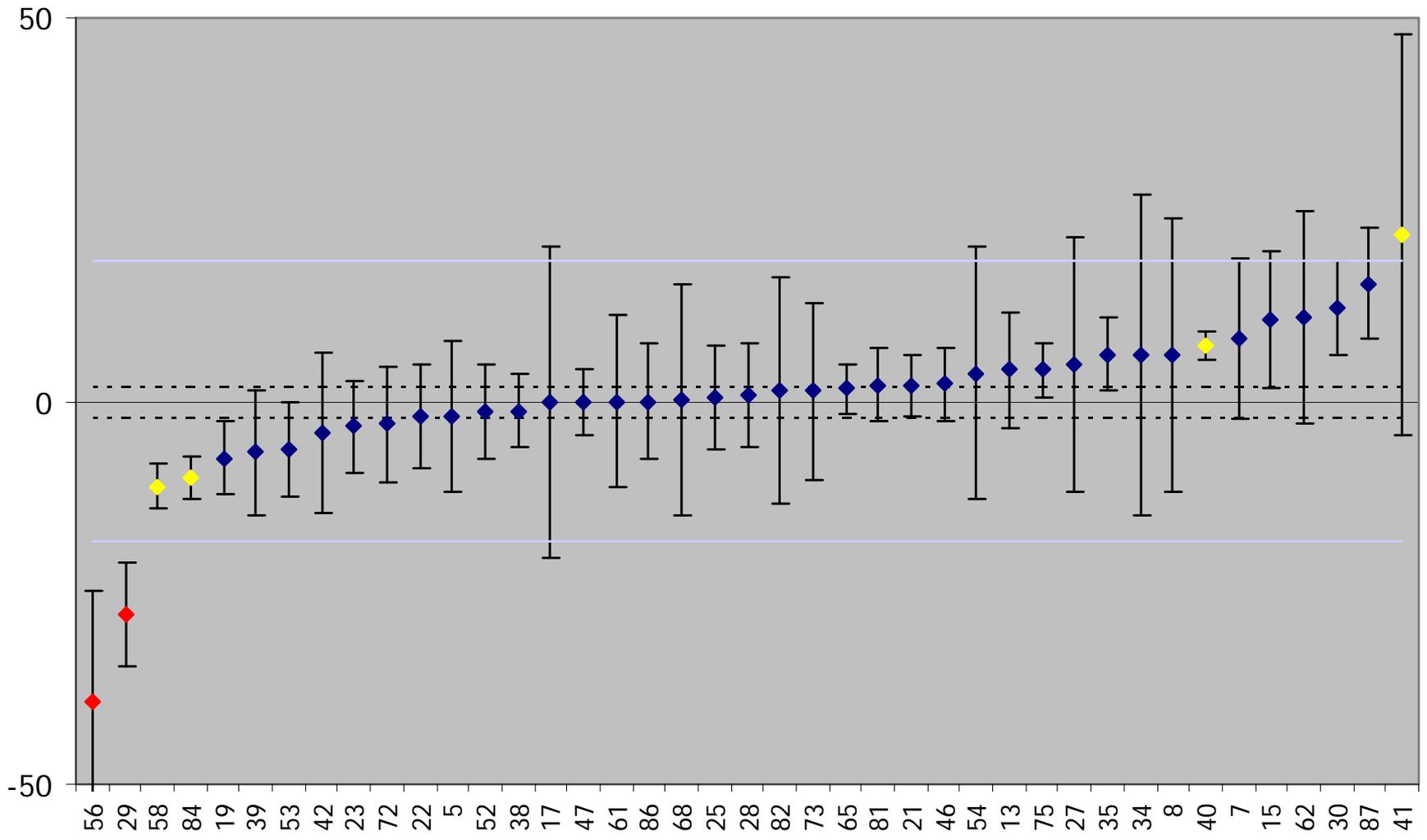**Deviation Cs-134 GL (%)**
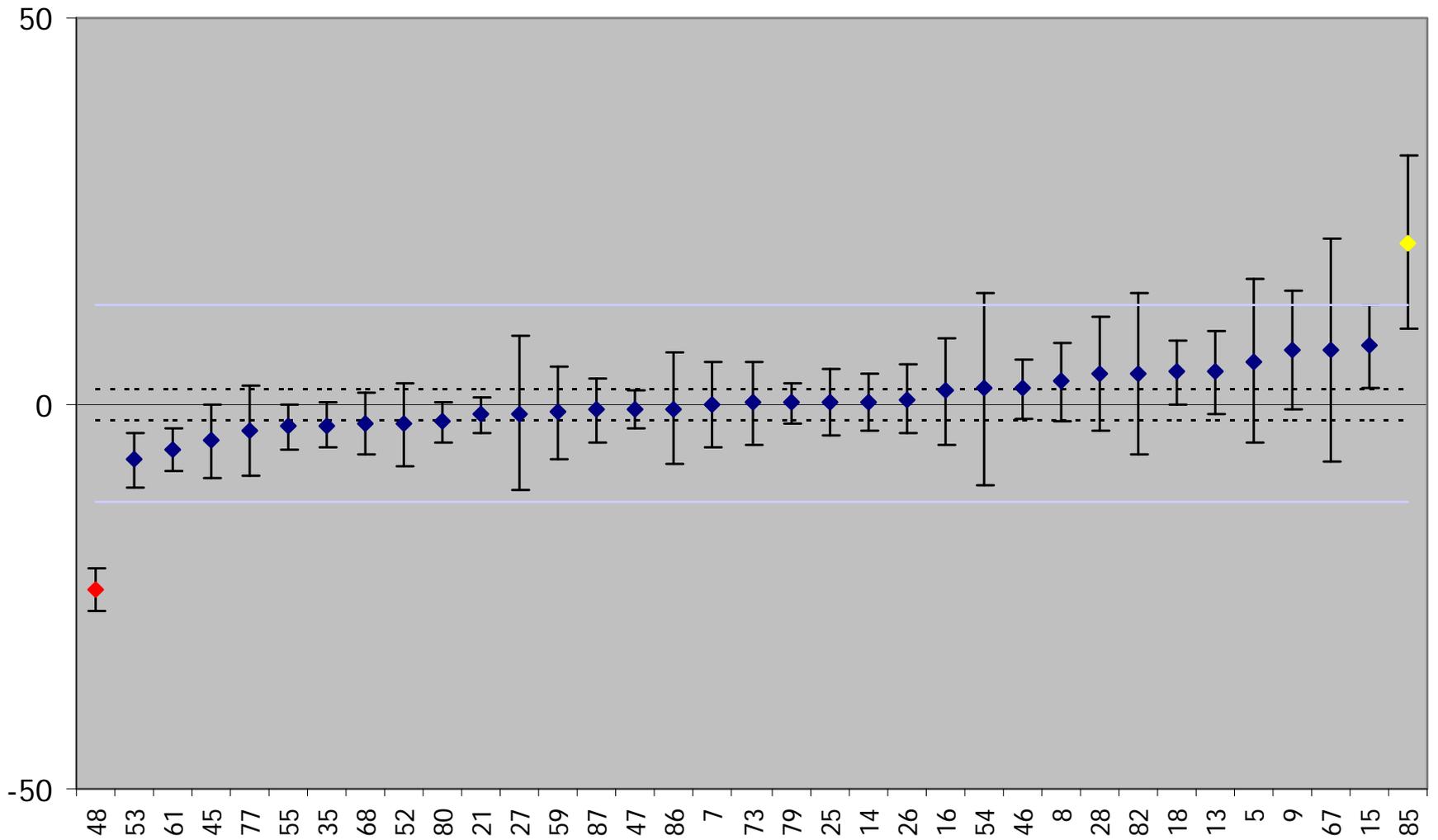
Deviation Cs-134 GH (%)

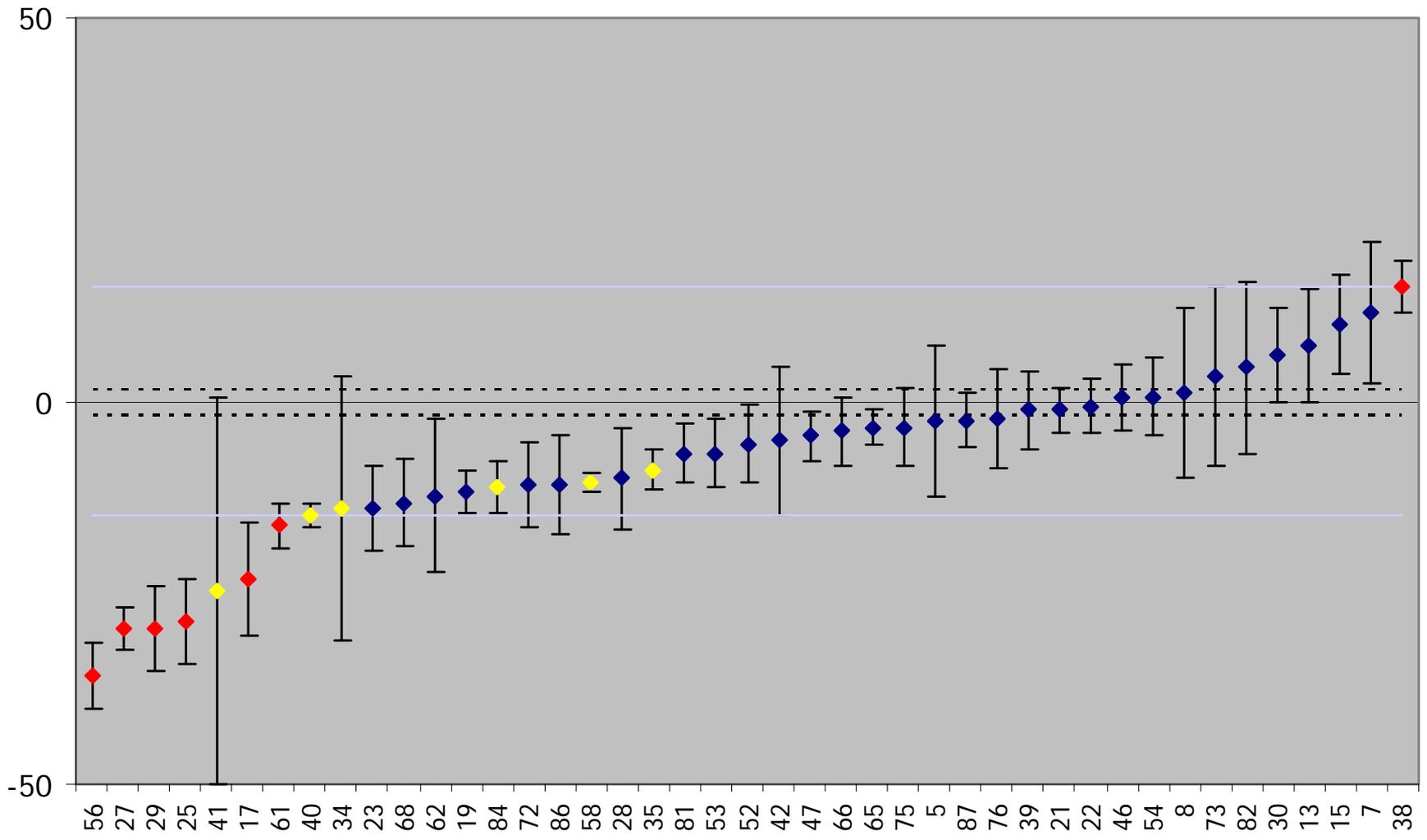Deviation Cs-137 GL (%)

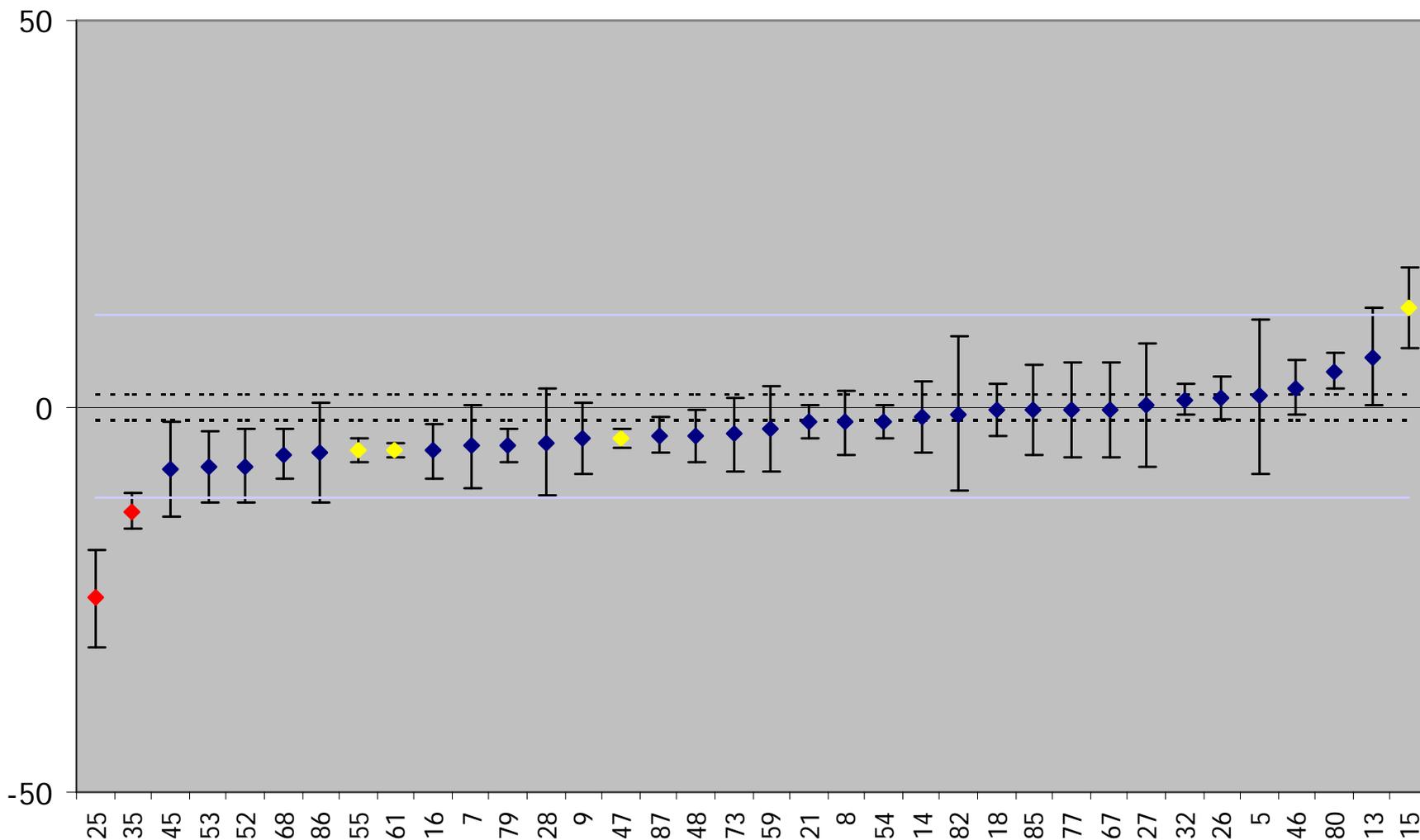Deviation Cs-137 GH (%)

Deviation Ce-144 GL (%)
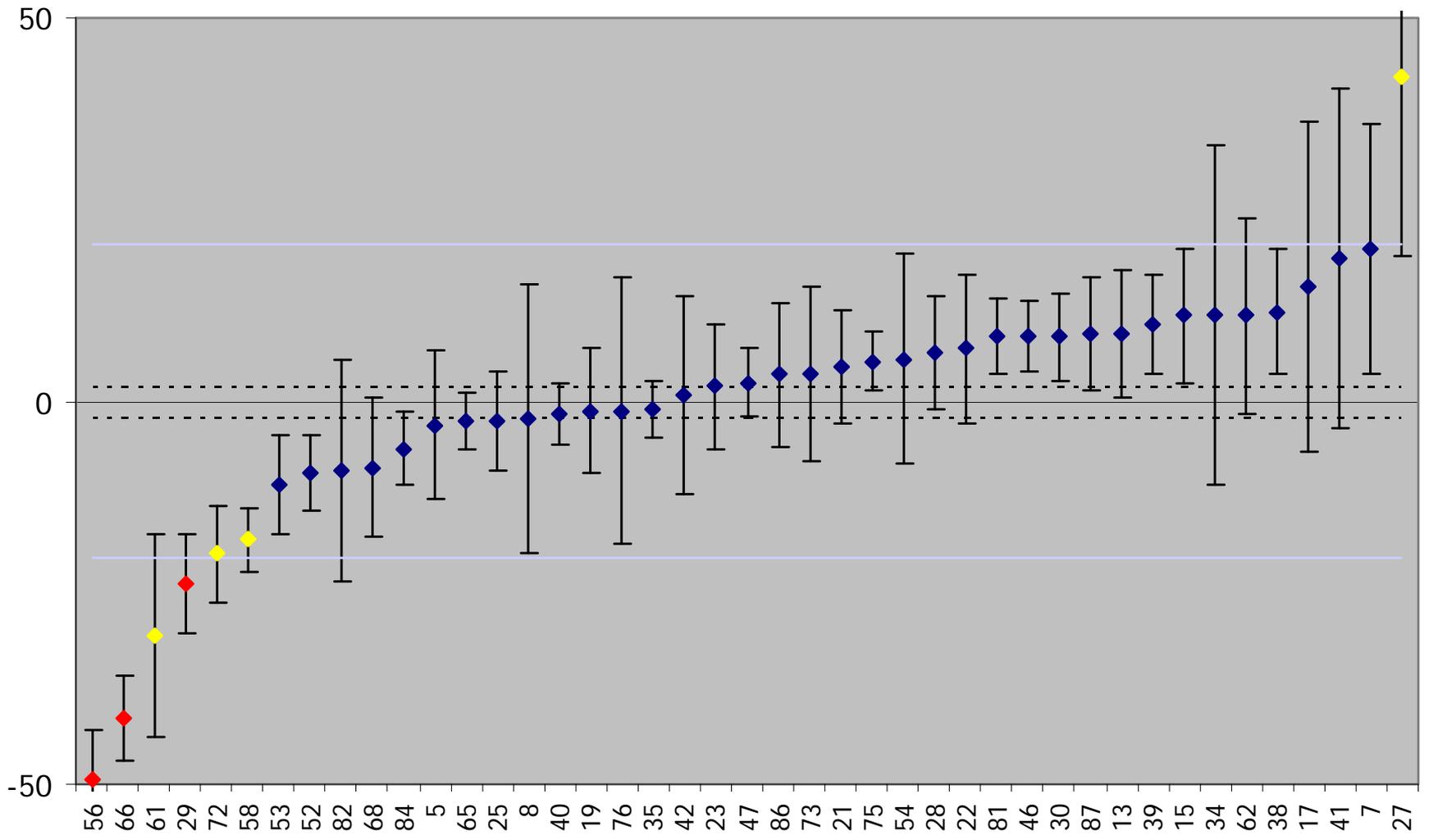
Deviation Ce-144 GH (%)

Deviation Eu-152 GL (%)
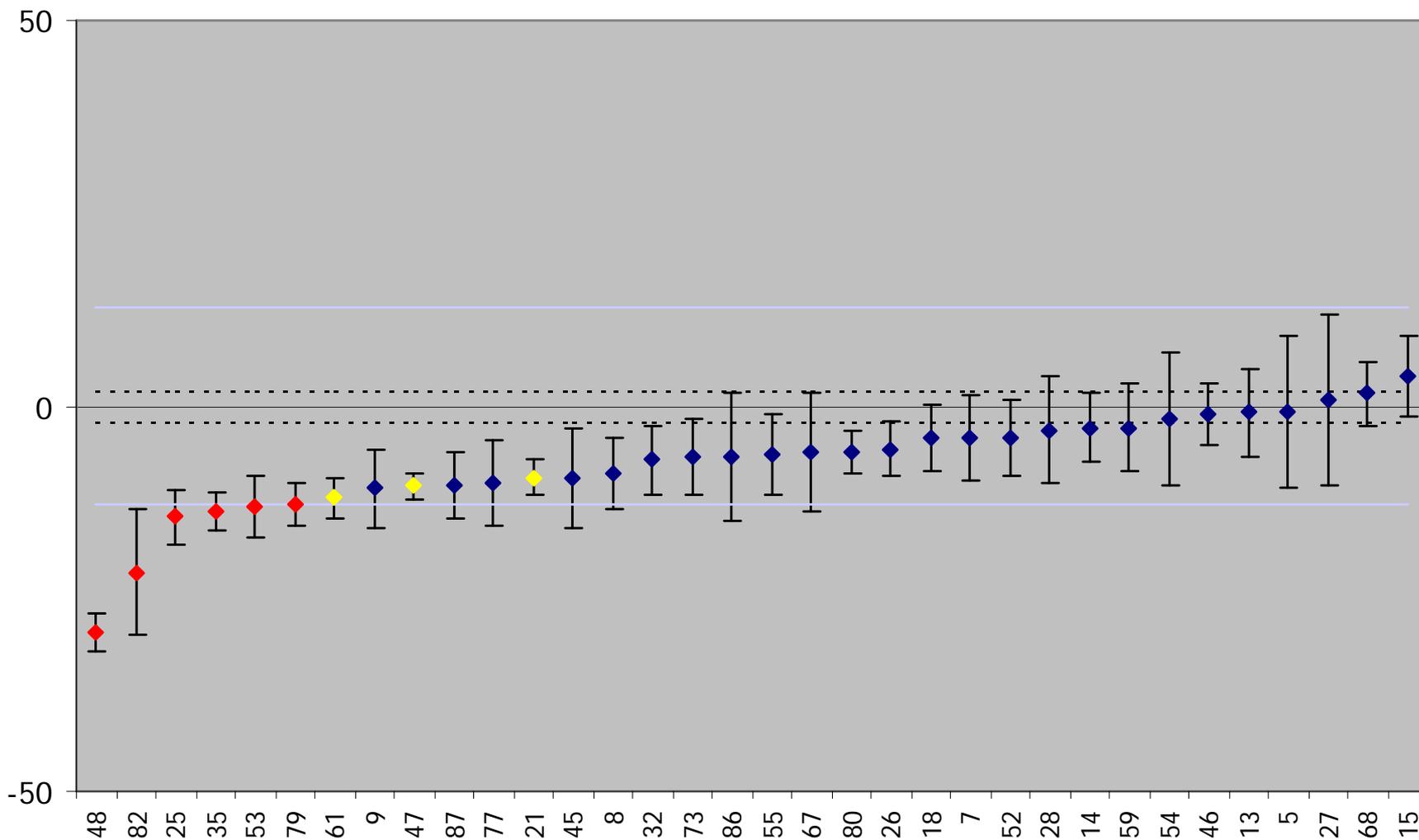
Deviation Eu-152 GH (%)

Deviation Eu-155 GL (%)

Deviation Eu-155 GH (%)

GL and GH results in agreement

	GL (%)	GH (%)
^{60}Co	82	85
^{95}Zr	62	74
^{95}Nb	29	46
^{125}Sb	78	85
^{133}Ba	73	77
^{134}Cs	71	64
^{137}Cs	89	79
^{144}Ce	78	85
^{152}Eu	64	77
^{155}Eu	80	64

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Results

71%   'in agreement'
14%   'questionable'
10%   'discrepant'
6%   'missing'

Problematic nuclides: ^{95}Zr, ^{95}Nb and ^{152}Eu

Less problematic: ^{60}Co, ^{125}Sb, ^{133}Ba, ^{134}Cs, ^{137}Cs, ^{144}Ce and ^{155}Eu

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Results GH

Results

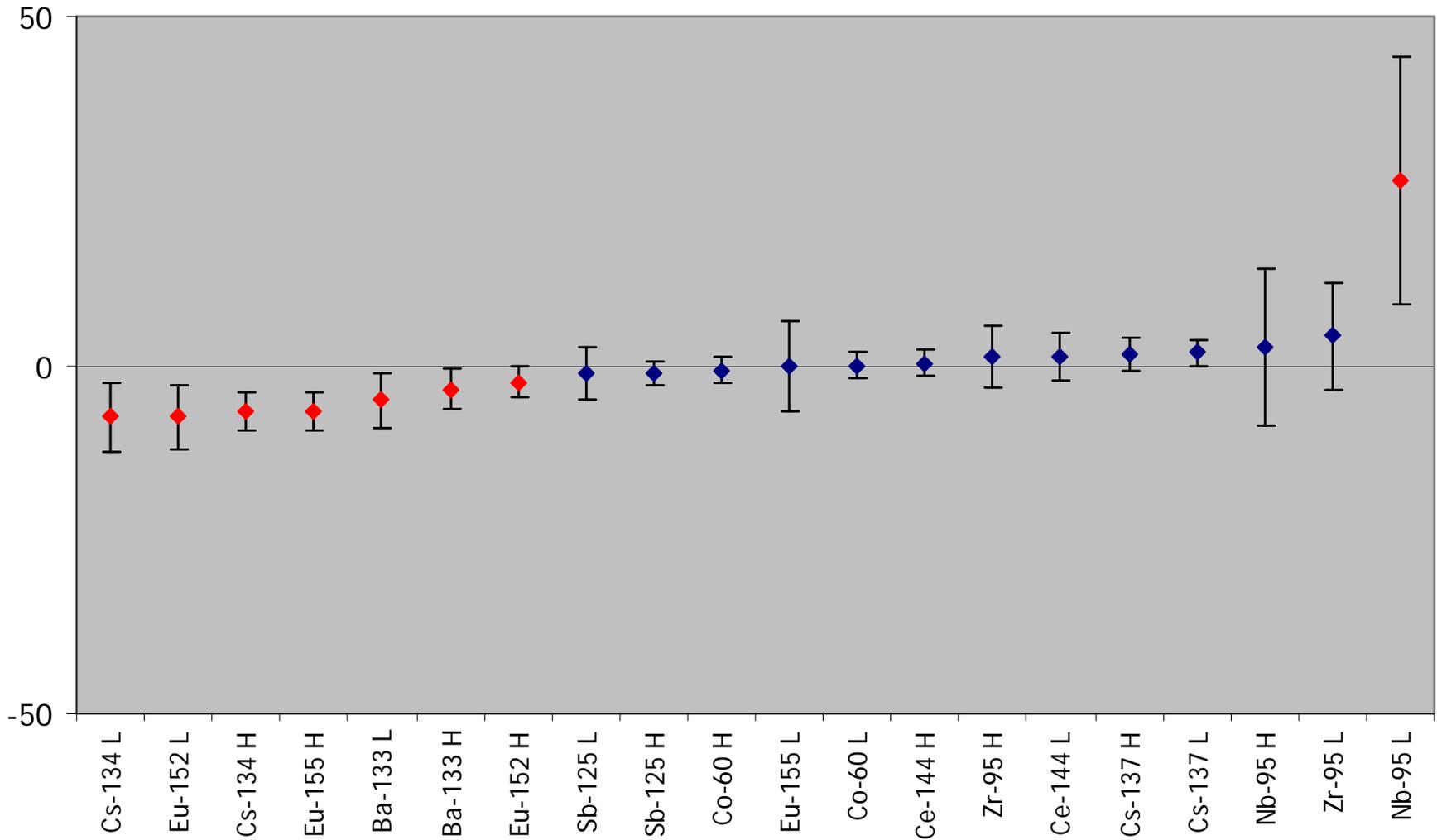|	
74%	'in agreement'
9%	'questionable'
9%	'discrepant'
8%	'missing'

Problematic nuclides: ^{95}Nb, ^{134}Cs and ^{155}Eu

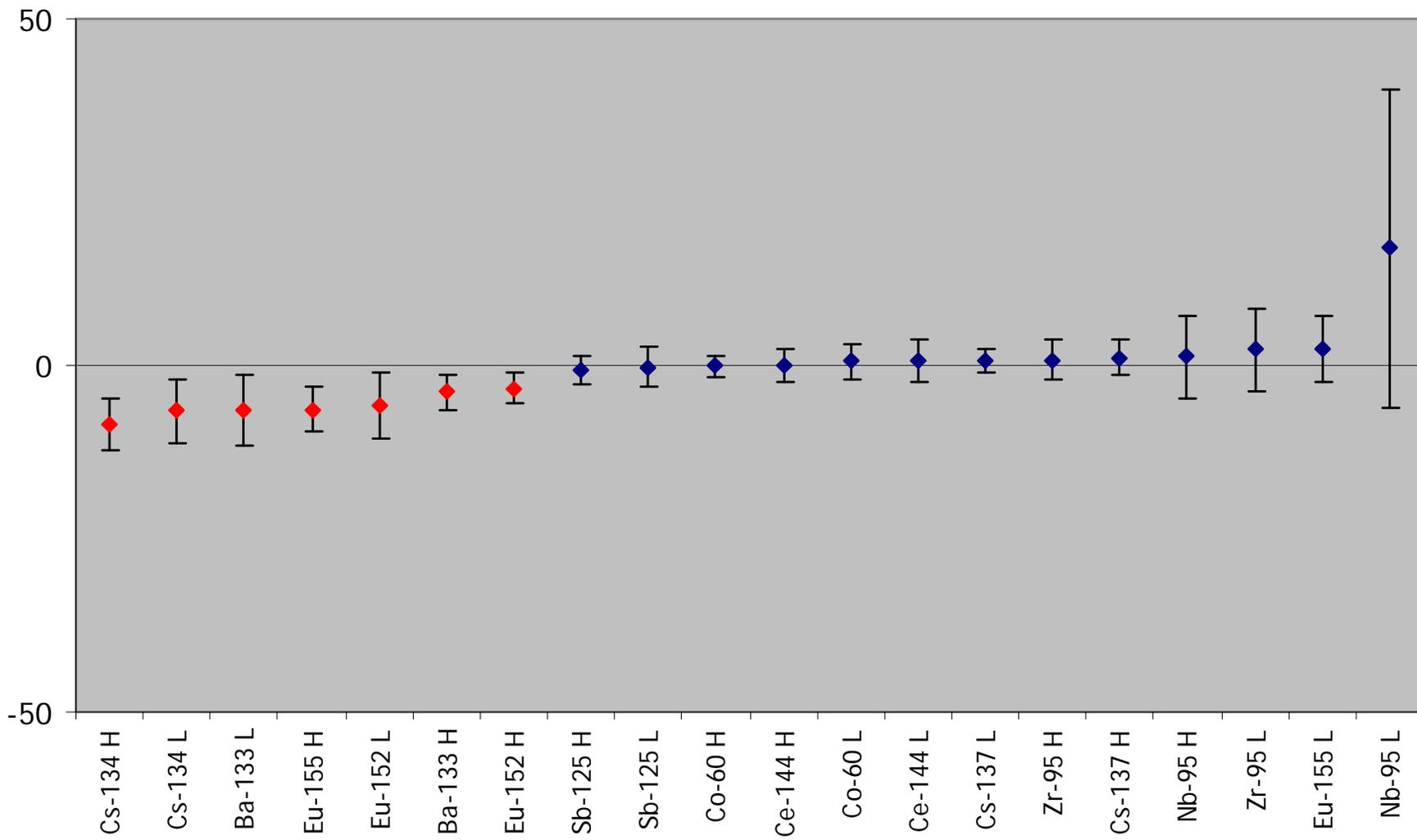Less problematic: ^{60}Co, ^{95}Zr, ^{125}Sb, ^{133}Ba, ^{137}Cs, ^{144}Cs and ^{152}Eu

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False positive identifications

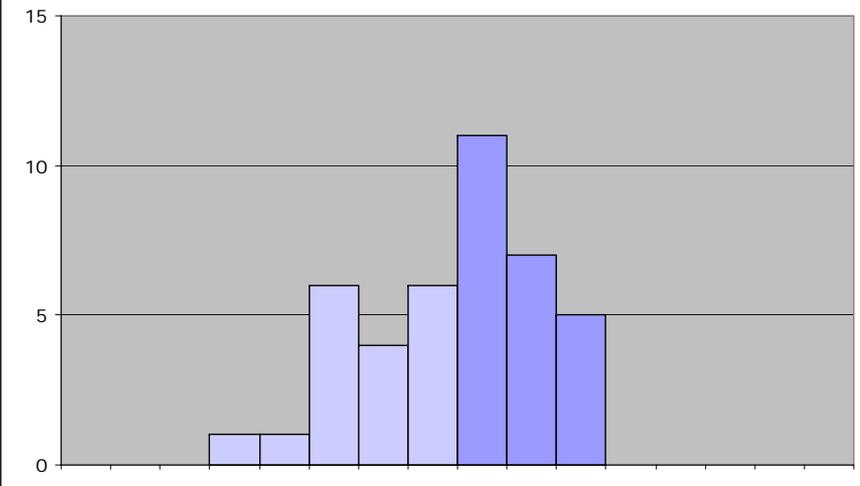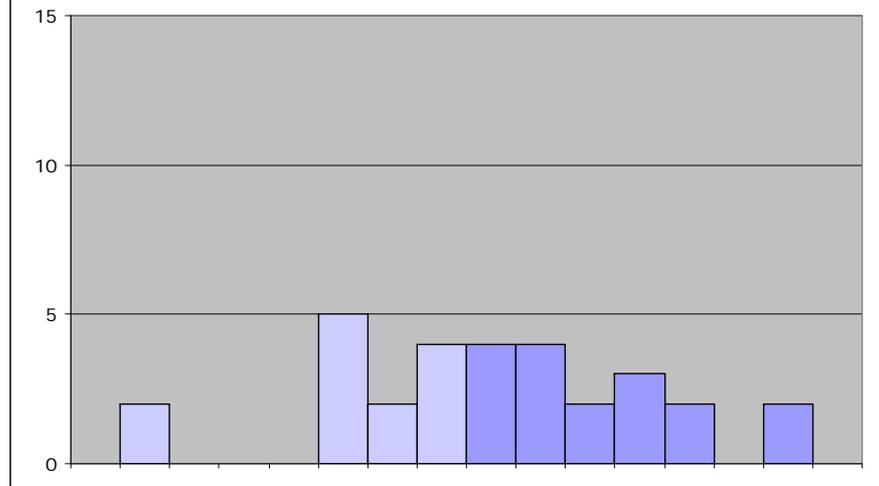|		
Na-22	2	?
Cr-51	3	Sb-125
Fe-59	1	Eu-152
Co-58	5	Eu-152
Zn-65	1	?
Cd-109	2	Eu-155
I-125	1	Sb-125
Am-241	3	Eu-155

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Mean deviation (%) with 99% conf. interval

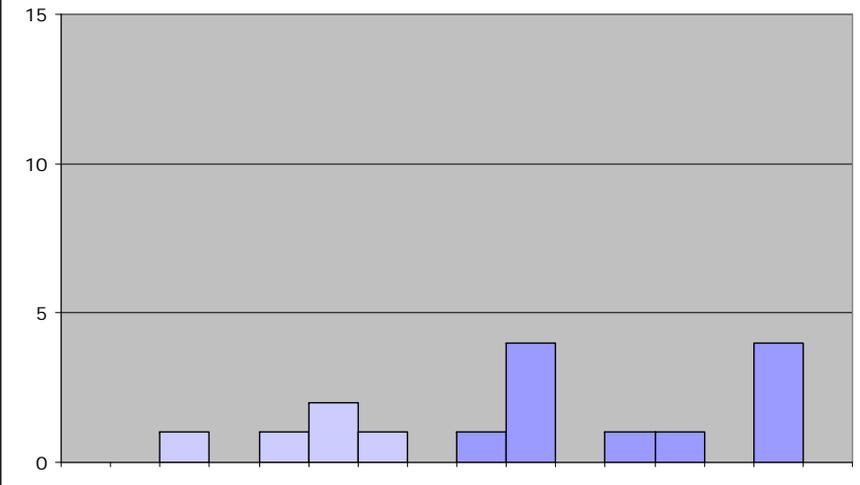**Median deviation (%) with 99% conf. interval**

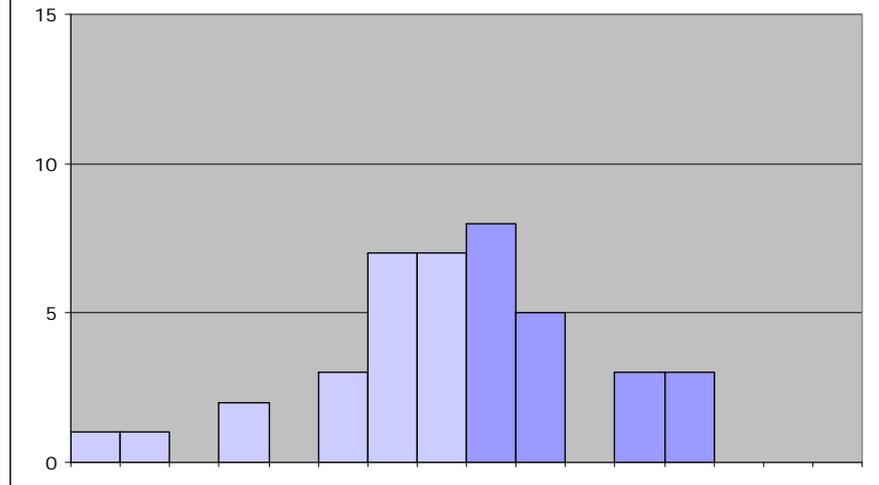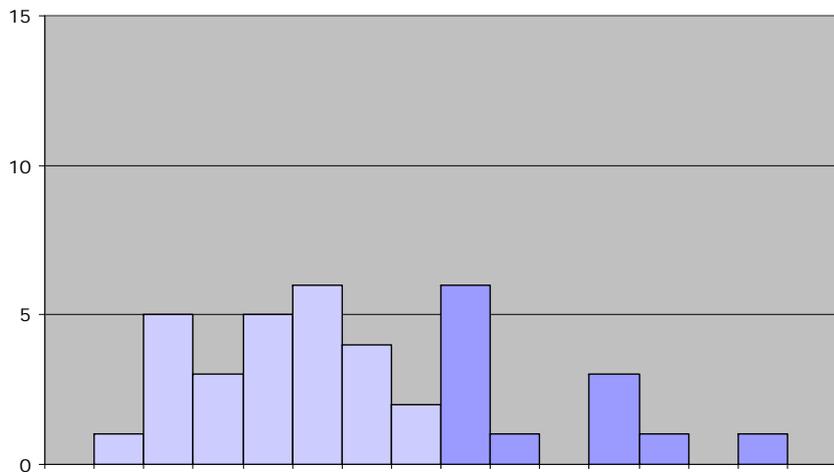**Co-60 deviation between -20% and 20%**

Zr-95 deviation between -20% and 20%

Nb-95 deviation between -20% and 20%

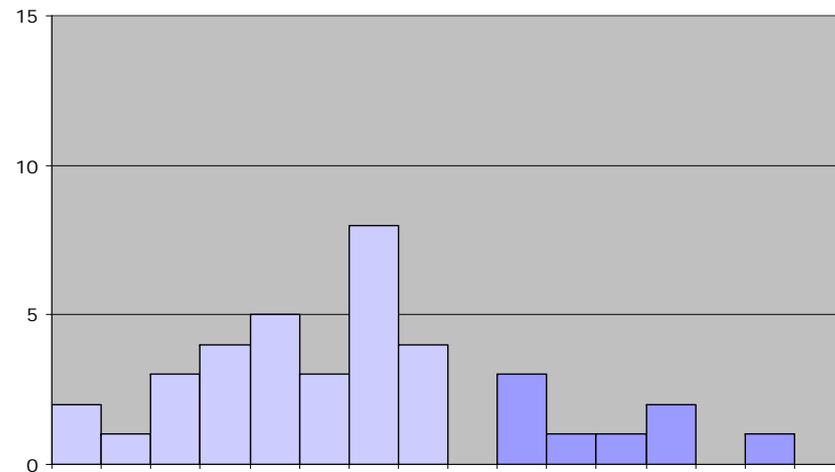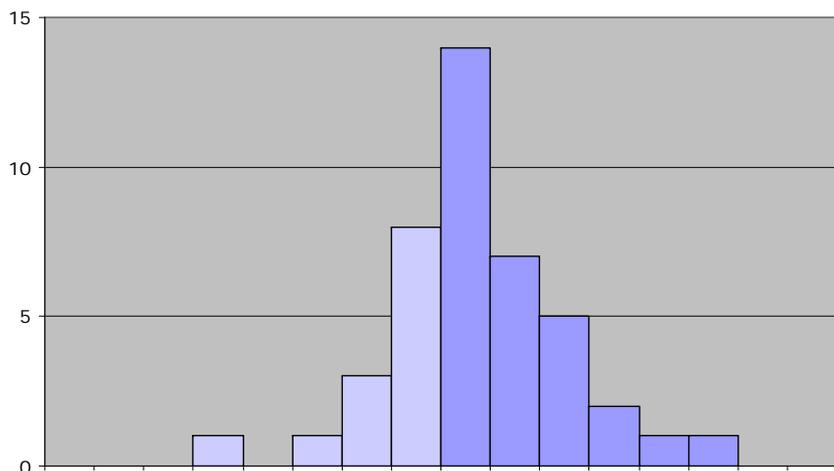**Sb-125 deviation between -20% and 20%**

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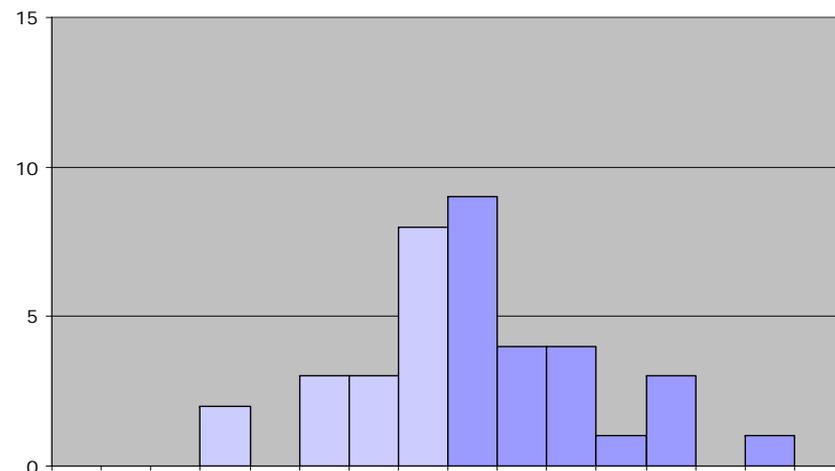**Ba-133 deviation between -20% and 20%**

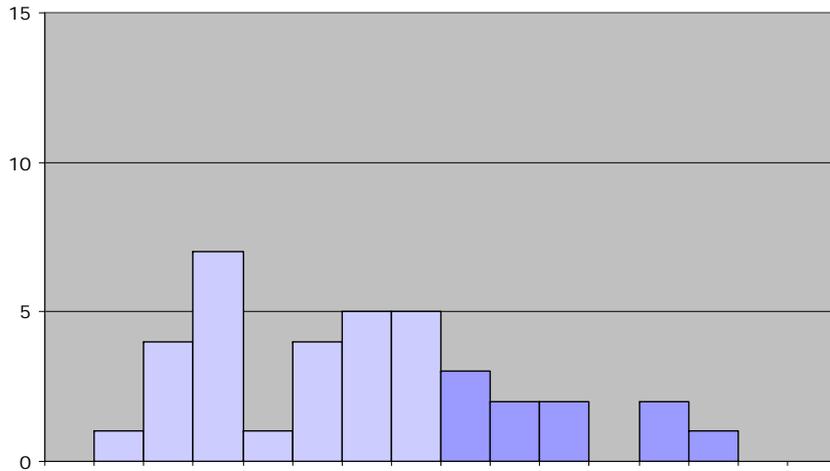**Cs-134 deviation between -20% and 20%**
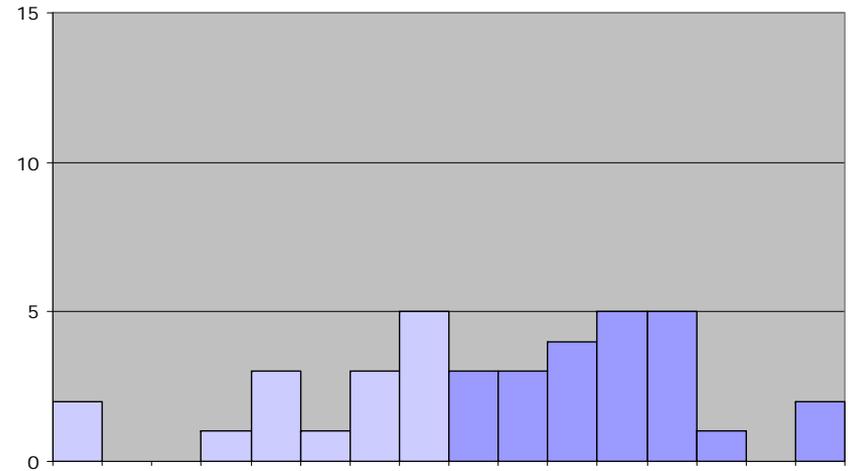
Cs-137 deviation between -20% and 20%

Ce-144 deviation between -20% and 20%

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Eu-152 deviation between -20% and 20%

Eu-155 deviation between -20% and 20%

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Thank you