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ENVIRONMENTAL RADIOACTIVITY COMPARISON EXERCISE 2005

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Environmental Radioactivity Comparison Exercise 2005

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1. INTRODUCTION

This environmental radioactivity comparison exercise was the twelfth in a series of similar exercises to have been conducted by NPL since 1989. The exercises are designed to identify analytical problems, to support UKAS accreditation and to provide a regular forum for discussion and technology transfer in this area. The exercises have been run approximately once every eighteen months by NPL. The range of sample types available for analysis has been mainly aqueous. In the 2005 exercise, five samples were available for analysis:

(i) ABL; a 'low-level' mixture of α-emitting and β-emitting radionuclides in 500 g of dilute nitric acid (1 – 20 Bq kg^{-1} per radionuclide)
(ii) ABH; a 'high-level' mixture of α-emitting and β-emitting radionuclides in 20 g of dilute nitric acid (1 – 20 Bq g^{-1} per radionuclide)
(iii) GL; a 'low-level' mixture of γ-emitting radionuclides in 500 g of dilute hydrochloric/oxalic acid (1 – 20 Bq kg^{-1} per radionuclide)
(iv) GH; a 'high-level' mixture of γ-emitting radionuclides in 100 g of dilute hydrochloric/oxalic acid (1 – 20 Bq g^{-1} per radionuclide)
(v) LB; a mixture of low energy β-emitting radionuclides in 500 g of very dilute sodium hydroxide solution (100 – 500 Bq kg^{-1} per radionuclide)

This document reports the execution of the exercise carried out by NPL to assess the performance of the participating laboratories. The main part of the exercise was to identify and/or traceably quantify the activity levels of radionuclides present in the samples. The tasks of NPL were to prepare and distribute the samples to the participating laboratories, to collect and interpret analysis results and to compile a comprehensive report.

The certified activity values of all nuclides were traceable to national standards of radioactivity. This traceability to national standards in turn provides traceability at an international level to the ultimate reference point of all measurements, the SI reference value maintained by the Bureau International des Poids et Mesures (BIPM).

The measurement of samples containing a mixture of radionuclides with an unknown (to the participants) composition was expected to demonstrate the participant's ability to (i) identify and quantify the activity levels of the radionuclides in the GL and/or GH sources without prior knowledge of the content, (ii) quantify the activity levels of the radionuclides in the ABL, ABH and/or LB sources without prior knowledge of the content, (iii) to complete the measurement in a timely manner and (iv) to provide a full uncertainty budget for the measurement.

As in previous exercises, a list of the radionuclides present in the ABL and ABH (both containing a mixture of ^{55}Fe, ^{89}Sr, ^{90}Sr, ^{238}U, ^{238}Pu, ^{239}Pu and ^{241}Am) and LB (containing a mixture of ^{3}H, ^{14}C and ^{35}S) mixtures was provided in advance of the exercise. A similar list was not provided for the GL and GH mixtures, since the measurement technique is non-invasive and enables unambiguous identification of the nuclides present, although the following candidate list of possible gamma-emitters was provided:

^{7}Be, ^{22}Na, ^{46}Sc, ^{54}Mn, ^{56}Co, ^{57}Co, ^{58}Co, ^{60}Co, ^{65}Zn, ^{85}Sr, ^{88}Y, ^{95}Zr, ^{95}Nb, ^{103}Ru ^{106}Ru/^{106}Rh, ^{109}Cd, ^{110m}Ag, ^{113}Sn, ^{124}Sb, ^{125}Sb, ^{133}Ba, ^{134}Cs, ^{137}Cs, ^{139}Ce, ^{141}Ce ^{144}Ce, ^{153}Gd, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{160}Tb, ^{166m}Ho, ^{170}Tm, ^{192}Ir, ^{203}Hg and ^{207}Bi.

The data treatment was changed compared to previous exercises. It was no longer sufficient to pass only the ‘u-test’ (in this report renamed ‘zeta test’ as recommended in ISO 13528). Two additional tests were introduced: the *z*-test and the relative uncertainty outlier test. A result was only classified as ‘in agreement’ when all three tests were passed. A failure to pass one of these tests resulted in a classification ‘questionable’. Failure of both the zeta test and the *z*-test resulted in a classification ‘discrepant’.

Furthermore, a new graphical representation of the data is presented: (i) the deviation plots are now colour-coded (dark blue points = results in agreement; yellow points = questionable results; red points = discrepant results); (ii) zeta score plots, relative uncertainty plots and ‘Kiri plots’, whose development was inspired by ‘Naji plots’, are now included. Finally, tables and figures listing the data sorted by participant are now included as well.

2. MATERIALS AND METHODS

2.1 Participants

A total of 48 participants took part in the exercise (28 from the United Kingdom and 20 from overseas organisations). A full listing is given in Appendix J. The majority of the samples taken were the GL and GH (both 34 participants). Uptake for the ABL, ABH and LB samples was 20, 16 and 26 respectively (for details see Appendix E).

2.2 Composition of samples

To prepare the sources, a number of standardised single radionuclide solutions were combined and diluted as necessary. This was performed in accordance with established procedures that have been independently accredited by the United Kingdom Accreditation Service (UKAS) for the production of solution standards of radioactivity. The final activity concentration for each nuclide was determined by dividing the initial single-radionuclide activity concentration by the dilution factors as determined from weighing (GDF). Sets of mixed-radionuclide sources were prepared and counted at each dilution stage in order to derive ‘radiometric’ dilution factors (RDF) to confirm those derived gravimetrically. The radionuclides included were all derived from existing stocks of radioactivity at NPL. The radionuclides were standardised as follows:

^{22}Na, **^{88}Y**, **^{89}Sr**, **^{133}Ba**, **^{134}Cs**, **^{137}Cs** and **^{152}Eu** – standardised in an ionisation chamber that had been calibrated by solutions that were standardised by coincidence counting techniques.

^{60}Co and **^{241}Am** – standardised by coincidence counting techniques.

^{125}Sb – standardised with coincidence and anticoincidence liquid scintillation counting.

^{35}S, **^{55}Fe** and **^{90}Sr** – standardised with liquid scintillation counting (CIEMAT / NIST efficiency tracing method with ^{3}H).

^{3}H, **^{14}C**, **^{238}U**, **^{238}Pu** and **^{239}Pu** – traceable to a national standard of radioactivity.

^{95}Zr and **^{95}Nb** – standardised with high-resolution gamma-ray spectrometry.

Each nuclide was checked for impurities either by alpha spectrometry, gamma-ray spectrometry or by reference to the original calibration certificate. The following impurities were found: ^{85}Sr (in the ^{89}Sr source), ^{154}Eu (in the ^{152}Eu source) and ^{240}Pu and ^{241}Pu (in the ^{239}Pu source). Negligible amounts of ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu were present in the ^{238}Pu source. A detailed overview of the source preparation and dilution checks can be found in Appendices C and D, respectively.

2.3 Reference time
The reference time for all activity concentrations is 1 October 2005 12:00 GMT. The initial deadline for the submission of results was 16 December 2005. In some cases, an extention of the deadline was granted (see Appendix E for details).

2.4 Detector systems

2.4.1 Gamma-ray spectrometry
"Maggie" is a calibrated detector with a high purity germanium n-type crystal with a relative efficiency of 11.1% at 1332 keV. It has a beryllium end cap to allow measurements at low energies. It is calibrated for 1 ml aqueous solution in a 2 ml ampoule. Calibration is achieved via ampoules containing single nuclide solutions which are either a) themselves calibrated on the NPL ionisation chambers or b) contain solutions standardised by absolute techniques at NPL. In this way the calibration is linked as closely to NPL primary standards as practicable. "Maggie" was used to determine the activity concentration of ^{95}Zr and ^{95}Nb. Impurity determinations of solutions assayed by ionisation chamber were performed on the same calibrated detector.

"Sir Robin" and "Galahad" are detectors with a high purity germanium p-type crystal with a relative efficiencies of 70% at 1332 keV. The crystal sits inside a low background lead shield consisting of an outer layer of 11 cm contemporary lead at 500 Bq kg^{-1} ^{210}Pb and an inner layer of 9 cm Tudor lead at 5-10 Bq kg^{-1} ^{210}Pb. There is no copper/cadmium grading as the sources assayed are typically not active enough to produce large amounts of X-rays. Neither layer of lead contains any antimony. "Sir Robin" and "Galahad" were used to perform measurements on the participants' samples required for QA purposes.

All systems use commercially available analogue electronics to condition and analyse the signals from the detectors. Top-end spectroscopy amplifiers (Canberra 2025 or Ortec 672) are used throughout to maximise stability and resolution. The data acquisition system consists of Canberra ADC/MCAs connected via an Ethernet network to three workstations running the Canberra Genie 2000 v2.1 software. The commercial software is used to control data acquisition and to determine peak areas only, with all subsequent calculations being performed by NPL staff. The calibrated detector "Maggie" uses the established pulser technique to perform dead time and pulse pile-up corrections. A high stability BNC PB5 pulser unit is used to provide tail pulses to the test input of the preamplifier such that an additional peak appears in the spectrum at 2.3 MeV. The pulse frequency is controlled by a calibrated NPL pulser unit which produces trigger pulses at a well-defined 10 Hz. The fraction of pulses observed in the spectrum is used to make an estimate of the losses due to dead time and pulse pile-up. A further correction is required to take account of the non-random nature of the pulses from the pulse generator, however this is usually insignificant at around 0.01%. The standard live time correction is applied on the environmental level detectors "Sir Robin" and "Galahad". This technique has been demonstrated to work well when the amplifier and ADC are matched and when the input count rate is not high. A well-type NaI(Tl) gamma-ray detector was used to confirm gravimetric dilution factors (GL and GH samples; see Appendix C for more details).

2.4.2 Liquid scintillation counting

A Packard (Packard Instrument Co., Meriden, CT, USA) Tri-Carb model 2700 TR scintillation spectrometer (0-2000 keV range), 20-ml low-potassium glass vials and EcoScint and Ultima Gold AB liquid scintillation cocktails were used to standardise ^{35}S, ^{55}Fe and ^{90}Sr. Each vial contained 10 g of liquid scintillation cocktail and 1.0 g of aqueous phase (containing either the ^{35}S, ^{55}Fe, ^{90}Sr or the ^{3}H standard source) resulting in a total volume of approximately 11 ml for all samples. Subsequently, the vials were swirled thoroughly and placed in the counter to cool and dark-adapt. Quenching was measured using the tSIE parameter (transformed Spectral Index of the External standard), which has a range of 0-1000, where 0 indicates a completely quenched sample and 1000 an unquenched sample, respectively. All count rates were corrected for background. The computer programmes CN2004 (PTB, Braunschweig, Germany), and Axum-7 were used to calculate the activities.

The same counter was also used to confirm gravimetric dilution factors for the ABL, ABH and LB samples (Cherenkov counting and liquid scintillation counting; see Appendix C for more details).

2.4.3 Ionisation Chamber

A TPA MkII ionisation chamber, which contains a counting gas of argon at 2 MPa, was used. This chamber has been monitored daily for almost 30 years using the same radium test source, and its variation in response has been found to be less than 0.1% over that period. The chamber converts ionising radiation into electrical current, which is measured using a voltage integrator circuit the important components of which are calibrated to national standards every six months. The conversion from current to source activity in Becquerels is nuclide-dependant, and is derived by measuring a source that has been standardised using primary standardisation methods. The chamber is linear over a large dynamic range (sub-pA equivalent activities up to micro-amps) and is intrinsically free from dead-time. Operation at the high end of the current range is only limited by space-charge recombination effects, where the density of ions in the chamber approaches a level where ions recombine before they are swept by the applied high voltage to the charge collection wires, thus diminishing the measured current and introducing a non-linear component into the chamber response.

The geometry of the source affects the response of the chamber, and so sources are typically decanted into standard vials of known composition and suspended inside the chamber using a special holder; corrections for source volume are also applied, as the depth of liquid in the standard vial also has a small effect on the overall response. Analysis of results is exceptionally simple – the accumulated charge in the feedback capacitor is derived from the voltage drop across it, and an average current is worked out based on the elapsed time of the measurement. The average current is then converted to source activity by applying the appropriate calibration factor. If the source is discovered to be contaminated (deduced from gamma-spectroscopy measurements, or half-life determinations) then it may be necessary to analyse the result using a multi-component model for the source; this does not introduce any significant complexity into the analysis.

2.5 Nuclides

2.5.1 ABL and ABH samples

The nuclides listed below were the principal radionuclides present in the ABL and ABH samples. The composition of the ABL and ABH samples was different compared to the last exercise: ^{99}Tc was dropped while ^{55}Fe, ^{89}Sr and ^{238}U were added. Also, this time the relative activities of the nuclides present in the ABL sample were not identical to the relative activities of the nuclides present in the ABH sample (i.e., the ABL samples were no longer a dilution of the ABH samples). Furthermore, the ranges of activity concentrations were increased from 2 – 5 Bq (k)g^{-1} to 1 – 20 Bq (k)g^{-1}.

2.5.1.1 Iron-55

This nuclide is produced by neutron activation of ^{54}Fe. It decays via electron capture to ^{55}Mn. Iron-55 may be present in environmental samples originating from the nuclear industry. Iron-55 was standardised with liquid scintillation counting (CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.1.2 Strontium-89

This relatively short-lived nuclide is formed by neutron induced fission of ^{235}U and ^{239}Pu (and/or neutron activation of ^{88}Sr). It decays by beta minus emissions (E_{max} = 1495 keV) to ^{89}Y. Significant activities of ^{89}Sr were released in the environment due to atmospheric nuclear weapon tests in the 1950s and 1960s and the Chernobyl accident, although this is now decayed to negligible environmental concentrations. Fission-produced ^{90}Sr is always accompanied by ^{89}Sr, which activity dominates in fresh mixtures of fission products. Strontium-89 was standardised with an ionisation chamber. The ^{89}Sr source contained a small amount of ^{85}Sr (0.26% of the total activity), which was determined with gamma spectrometry.

2.5.1.3 Strontium-90

This nuclide is produced by neutron induced fission of ^{235}U and ^{239}Pu. It decays by beta minus emissions (E_{max} = 546 keV) to ^{90}Y which subsequently decays by beta minus emissions (E_{max} = 2280 keV) to ^{90}Zr. It occurs widely in the environment as a result of weapon tests and discharges from the nuclear industry. The ^{90}Sr source was standardised with liquid scintillation counting (CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.1.4 Uranium-238

This naturally occuring primordial nuclide decays mainly by emission of alpha particles to ^{234}Th. It occurs widely in the environment. The ^{238}U source was traceable to a national standard of radioactivity. The activities of ^{233}U, ^{234}U, ^{235}U and ^{236}U in the source were less than 0.25% in total.

2.5.1.5 Plutonium-238

This nuclide is produced by neutron activation of ^{237}Np (after decay of short-lived ^{238}Np). It decays mainly by emission of alpha particles to ^{234}U. It occurs in the environment as a result of discharges from the nuclear industry. The plutonium-238 source was traceable to a national standard of radioactivity. The ^{238}Pu source contained a small amount of contaminants (^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu; combined 0.01% of the total activity).

2.5.1.6 Plutonium-239
This nuclide is produced by neutron activation of ^{238}U (after decay of short-lived ^{239}U and ^{239}Np). It decays mainly by emission of alpha particles to ^{235m}U which subsequently decays by isomeric transition to ^{235}U. It occurs widely in the environment as a result of weapon tests and discharges from the nuclear industry. The ^{239}Pu source was traceable to a national standard of radioactivity. The source contained a small amount of contaminants (^{240}Pu, ^{241}Pu and ^{241}Am; 1% of the total activity).

2.5.1.7 Americium-241
This nuclide is produced by the decay of ^{241}Pu. It decays mainly by emission of alpha particles to ^{237}Np. It occurs widely in the environment as a result of weapon tests and discharges from the nuclear industry. The ^{241}Am source was standardised by coincidence counting techniques.

2.5.2 GH and GL samples

The nuclides listed below were the principal radionuclides added to the gamma emitting samples (GL and GH). The composition of the GL and GH samples was different compared to the last exercise: ^{106}Ru, ^{144}Ce and ^{154}Eu were dropped while ^{22}Na, ^{88}Y, ^{95}Nb, ^{125}Sb, ^{133}Ba and ^{152}Eu were added. Also, this time the relative activities of the nuclides present in the GL sample were not identical to the relative activities of the nuclides present in the GH sample (i.e., the GL samples were no longer a dilution of the GH samples). Furthermore, the ranges of activity concentrations were increased from 1 – 10 Bq g^{-1} and 2 – 12 Bq kg^{-1} to 1 – 20 Bq (k)g^{-1}.

2.5.2.1 Sodium-22
This nuclide, which may be produced by charged particle reactions, decays via beta plus emissions (90%) and electron capture (10%) to ^{22}Ne. The probability of producing a gamma-ray emission at 511 keV and 1275 keV are 1.798(2) and 0.99940(14), respectively. This nuclide may show coincidence summing effects on high efficiency detectors. Sodium-22 may be present in some decommisioning waste and may be used as a calibration nuclide. Sodium-22 was standardised with an ionisation chamber.

2.5.2.2 Cobalt-60
This nuclide is mainly produced by neutron activation of ^{59}Co. It decays by beta minus emissions to ^{60}Ni. The percentage of disintegrations producing a gamma-ray emission at 1173 and 1332 keV is 99.85(3)% and 99.9826(6)%, respectively. This nuclide may show coincidence summing effects on high efficiency detectors. Cobalt-60 is present in the environment due to discharges from the nuclear industry and it is used as a calibration nuclide. Cobalt-60 was standardised by coincidence counting techniques.

2.5.2.3 Yttrium-88
This nuclide, which may be produced by charged particle reactions, decays by electron capture and beta plus emissions to ^{88}Sr. It may show coincidence summing effects on high efficiency detectors. It is unlikely to be present in the environment but

it is used as a calibration nuclide. Yttrium-88 was standardised with an ionisation chamber.

2.5.2.4 Zirconium-95

This fission product decays by beta minus emissions to both ^{95}Nb (98.8%) and ^{95m}Nb (1.2%). Significant activities of ^{95}Zr were released in the environment due to atmospheric nuclear weapon tests in the 1950s and 1960s and the Chernobyl accident, although this has now decayed to negligible environmental concentrations. The ^{95}Zr was produced in a nuclear reactor by neutron-induced fission of 99.9% enriched ^{235}U, followed by chemical separation from other fission products and ^{235}U. Zirconium-95 was standardised with gamma-ray spectrometry.

2.5.2.5 Niobium-95

This radionuclide is the daughter of both ^{95}Zr and ^{95m}Nb and is therefore present in a ^{95}Zr source due to ingrowth. The ^{95}Zr / ^{95}Nb system was not in equilibrium at the time of measurement, due to the relatively long half life of the ^{95}Nb. Niobium-95 decays by beta minus emissions to ^{95}Mo excited levels. A modified form of the Bateman equations taking account of the multiple branching of the parents must be used to determine the activity concentration as a function of time. Niobium-95 was standardised with gamma-ray spectrometry.

2.5.2.6 Antimony-125

This fission product decays by beta minus emissions to ^{125}Te excited levels. Antimony-125 is present in the environment due to discharges from the nuclear industry. There are a large number of high energy gamma-ray emissions in the decay, some of which are coincident with one another and some coincidence summing effects may be expected. The percentage of disintegrations to ^{125m}Te ($T_{½}$ = 57 d) is 22.9(9)%. Due to the relatively long half-life of the ^{125m}Te, the system may not be in equilibrium at the time of measurement. Antimony-125 was standardised with coincidence and anticoincidence liquid scintillation counting.

2.5.2.7 Barium-133

This nuclide decays by electron capture to ^{133}Cs excited levels. Barium-133 is unlikely to be present in the environment, but it is well known as a nuclide which shows coincidence summing effects on high efficiency detectors. Barium-133 was standardised with an ionisation chamber.

2.5.2.8 Caesium-134

This activation product decays by beta plus emissions to ^{134}Xe excited levels and by beta minus emissions to ^{134}Ba excited levels. It is present in nuclear waste and various ecosystems. Caesium-134 is well known as a nuclide which shows large coincidence summing effects on high efficiency detectors. Caesium-134 was standardised with an ionisation chamber.

2.5.2.9 Caesium-137

This fission product decays by beta minus emission to ^{137m}Ba which subsequently decays by isomeric transition with the emission of a 662 keV gamma-ray line. The half-life of ^{137m}Ba is so short at 2.6 minutes that effectively the 662 keV line may be considered a gamma-ray emission of ^{137}Cs for most purposes. It occurs widely in the environment and it is also used as a calibration nuclide. Caesium-137 was standardised with an ionisation chamber.

2.5.2.10 Europium-152

This activation product decays via electron capture (72%) to ^{152}Sm excited levels and by beta minus emissions (28%) to ^{152}Gd excited levels. Europium-152 is unlikely to be present in the environment, but it is well known as a nuclide which shows large coincidence summing effects on high efficiency detectors. Europium-152 was standardised with an ionisation chamber. Europium-154, which was present as a minor impurity (0.3% of the total activity), was determined with gamma-ray spectrometry.

2.5.3 LB samples

The nuclides listed below were the principal radionuclides present in the LB samples. The composition of the low-energy beta emitter (LB) sample was different compared to the last exercise: ^{129}I was dropped while ^{14}C and ^{35}S were added. Furthermore, the range of activity concentrations was changed from 400 – 550 Bq kg^{-1} to 100 – 500 Bq kg^{-1}.

2.5.3.1 Hydrogen-3 (Tritium)

This nuclide is produced by neutron activation of deuterium and neutron induced fission and spallation. It occurs widely in the environment as a result of cosmic ray interactions, releases from nuclear weapon tests and discharges from the nuclear industry. It decays by beta minus emissions ($E_{\max}$ = 18.6 keV) to ^{3}He. The chemical form of ^{3}H in the LB samples was tritiated water. The hydrogen-3 source was traceable to a national standard of radioactivity.

2.5.3.2 Carbon-14

This nuclide is formed by interaction of ^{14}N with neutrons produced in the upper atmosphere by cosmic-ray interactions. It decays by beta minus emissions ($E_{\max}$ = 156 keV) to ^{14}N. It occurs widely in the environment as a result of the natural process mentioned above and as a result of releases from nuclear weapon tests and discharges from the nuclear industry. The chemical form of ^{14}C in the LB samples was carbonate. The carbon-14 source was traceable to a national standard of radioactivity.

2.5.3.3 Sulphur-35

This nuclide is produced by neutron activation of ^{34}S or ^{35}Cl. It decays by beta minus emissions ($E_{\max}$ = 167 keV) to ^{35}Cl. It occurs in some environmental samples, due to discharges from the nuclear industry.The chemical form of ^{35}S in the LB samples was sulphate. Sulphur-35 was standardised with liquid scintillation counting (CIEMAT / NIST efficiency tracing with ^{3}H).

2.6 Treatment of data

The laboratory data were reported back to the participants in order for the participants to check for gross errors. The deviation from the the assigned (NPL) value for each laboratory value is given by:

$$D = 100\frac{L-N}{N} = 100\left(\frac{L}{N}-1\right) \qquad [1]$$

The error bars in the graphs represent the standard uncertainty (k=1) of the deviation:

$$u_{\mathrm{D}} = 100\frac{L}{N}\sqrt{\left(\frac{u_{\mathrm{L}}}{L}\right)^2 + \left(\frac{u_{\mathrm{N}}}{N}\right)^2} \qquad [2]$$

The results were evaluated by three tests:

$$\zeta = \frac{L-N}{\sqrt{u_{\mathrm{L}}^2 + u_{\mathrm{N}}^2}} \qquad [3]$$

$$R_L = \frac{u_{\mathrm{L}}}{L} \qquad [4]$$

$$z = \frac{L-N}{\sigma_p} = \frac{L-N}{R_{\mathrm{med}}N} \qquad [5]$$

where:

D	–	deviation from the assigned value	(unit: %)
L	–	laboratory value	(unit: Bq kg^{-1} or Bq g^{-1})
N	–	assigned value	(unit: Bq kg^{-1} or Bq g^{-1})
u_{D}	–	standard uncertainty of the deviation	(unit: %)
u_{L}	–	standard uncertainty of the laboratory value	(unit: Bq kg^{-1} or Bq g^{-1})
u_{N}	–	standard uncertainty of the assigned value	(unit: Bq kg^{-1} or Bq g^{-1})
ζ	–	zeta score	
R_{L}	–	relative uncertainty of the laboratory value	
z	–	z-score	
σ_{p}	–	standard uncertainty for proficiency assessment	(unit: Bq kg^{-1} or Bq g^{-1})
R_{med}	–	median of the R_{L} values	

The zeta and z-scores were used to determine whether the difference between the laboratory value and the assigned value is significantly different from zero. One-sided Dixon's Q outlier tests (see Table F1; Appendix F) were used to determine whether the relative uncertainty of the laboratory value R_{L} is significantly larger than the other values in the data set.

Results for which the absolute values of the zeta score and the z-score were both ≤ 2.58 (corresponding to a significance levels of α = 0.01) and a relative uncertainty R_{L} not significantly larger than the other values in the data set is taken to mean that the laboratory value is '**in agreement**' (dark blue points). If either (i) the relative uncertainty R_L is significantly larger than the other values in the data set, (ii) the result passes the zeta test but not the z-test (large deviation from the assigned value combined with a large uncertainty), or (iii) the result passes the z-test but not the zeta test (small deviation from the assigned value and combined with a small uncertainty), the laboratory value is classified as '**questionable**' (yellow points). If the absolute values of both the zeta score and the z-score > 2.58, then the laboratory value is classified as '**discrepant**' from the assigned value (red points), whatever the value of its relative uncertainty R_L.

The zeta score and the z-score are related by the Equation 6:

$$\zeta = \frac{\sigma_P}{\sqrt{u_L^2 + u_N^2}} z \qquad [6]$$

This can be rewritten as:

$$\frac{z^2}{\zeta^2} - \frac{u_N^2}{\sigma_P^2} = \frac{u_L^2}{\sigma_P^2} \qquad [7]$$

The relative uncertainty of the laboratory R_L and the z-score are related by Equation 8:

$$\frac{u_L}{R_L} = z\sigma_P + N \qquad [8]$$

This can be rewritten as:

$$R_L^2 \left(z + \frac{N}{\sigma_P} \right)^2 = \frac{u_L^2}{\sigma_P^2} \qquad [9]$$

'Kiri' plots were constructed by plotting the squares of the ratio between the uncertainty u_L and the target uncertainty σ_p against the z-score. The central parabola represents a zeta score of 2.58. The left parabola represents the outlier limit R_{lim} of the relative laboratory uncertainty R_L.

Data points that are inside the $\zeta = 2.58$ parabola (i.e., for which $\zeta \leq 2.58$), a $-2.58 \leq z$-score ≤ 2.58 and outside the R_{lim} parabola (i.e., for which $R_L \leq R_{lim}$) are '**in agreement**' (dark blue points).

'**Questionable**' data points (yellow points), which fail either the z-test, the zeta test or the relative uncertainty outlier test (but not both the z-test and zeta test), are either:

(i) inside the $\zeta = 2.58$ parabola with a z-score < –2.58* or > 2.58,

(ii) outside the $\zeta = 2.58$ parabola with a $-2.58 \leq z$-score ≤ 2.58 or

(iii) inside the $\zeta = 2.58$ parabola with a $-2.58 \leq z$-score ≤ 2.58 but inside the R_{lim} parabola (i.e., for which $R_L > R_{lim}$).

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* Please note that the z-test value $\geq (-N / \sigma_p)$ by definition

All other data points are '**discrepant**' (red points).

The unweighted means and 99% confidence intervals for the laboratories' deviation results were calculated by excluding outliers. Outliers were excluded by two-sided Dixon's Q outlier tests (see Table F2; Appendix F).

2.7 Uncertainties

Uncertainties quoted in this report are (combined) standard uncertainties with a coverage factor of k=1, unless otherwise indicated. The numerical result of a measurement is stated in the xxx(y) format, where the number in parentheses is the numerical value of the standard uncertainty referred to the corresponding last digits of the quoted result. The ± format is used to indicate a 99% confidence interval.

2.8 Nuclear data

This was not supplied to the participants, but currently recommended values for half-life data are given in Appendix G and these are the values used by NPL to provide the reference values in this exercise. Although there are discrepancies between the half-life data used by NPL and those used by the participants, the differences are minor and make little or no difference to the overall result. The choice of gamma-ray emission probabilities assumes similar importance to the half-life values in this exercise, although the choice is an important one, affecting as it does the calculation of the final result. Minor differences probably do not contribute greatly to the overall acceptability of any particular result, although in the interests of assuring the quality of data reported and minimising discrepancies between laboratories, it would be in the interests of all concerned to use a common data set.

2.9 Niobium-95 and Zirconium-95

Zirconium-95 decays to both ^{95}Nb (98.9%) and ^{95m}Nb (1.1%). Niobium-95m decays to both ^{95}Nb (97.5%) and stable ^{95}Mo (2.5%) and was in secular equilibrium with its mother ^{95}Zr at the reference time. Niobium-95 is the daughter of both ^{95}Zr and ^{95m}Nb and was therefore present in the ^{95}Zr source due to ingrowth. The ^{95}Zr / ^{95}Nb system was not in transient equilibrium at the reference time, due to the relatively long half life of ^{95}Nb. A modified form of the Bateman equations taking account of the multiple branching of the parents must be used to determine the activity concentration as a function of time. The ^{95}Nb / ^{95}Zr ratio as a function of time is given by Equation [10]:

$$\frac{A_3(t)}{A_1(t)} = \frac{(1-p)\lambda_3}{(\lambda_3-\lambda_1)}\left(1-e^{(\lambda_1-\lambda_3)t}\right) + \frac{q\,p\,\lambda_2\,\lambda_3}{(\lambda_2-\lambda_1)}\left[\frac{\left(1-e^{(\lambda_1-\lambda_3)t}\right)}{(\lambda_3-\lambda_1)} - \frac{\left(e^{(\lambda_1-\lambda_2)t}-e^{(\lambda_1-\lambda_3)t}\right)}{(\lambda_3-\lambda_2)}\right] \qquad [10]$$

for $t \to \infty$, *and* $\lambda_1 \langle \lambda_3 \langle \lambda_2$ *then*

$$\frac{A_3(\infty)}{A_1(\infty)} = \frac{(1-p)\lambda_3}{(\lambda_3-\lambda_1)} + \frac{q\,p\,\lambda_2\,\lambda_3}{(\lambda_2-\lambda_1)}\left[\frac{1}{(\lambda_3-\lambda_1)}\right] = \frac{\lambda_3}{(\lambda_3-\lambda_1)}\left[1-p+\frac{q\,p\,\lambda_2}{(\lambda_2-\lambda_1)}\right] = 2.206 \qquad [11]$$

where:

$A_1(t)$	– ^{95}Zr activity at time t	
$A_3(t)$	– ^{95}Nb activity at time t	
λ_1	– decay constant ^{95}Zr:	0.0108250(10) d^{-1}
λ_2	– decay constant ^{95m}Nb:	0.1920(16) d^{-1}
λ_3	– decay constant ^{95}Nb:	0.019809(4) d^{-1}
p	– decay probability of ^{95}Zr to ^{95m}Nb:	0.0112(10)
q	– decay probability of ^{95m}Nb to ^{95}Nb:	0.975(1)
t	– time since separation	

This equation reduces to a transient equilibrium equation by setting $p = 0$.

$$\frac{A_3(\infty)}{A_1(\infty)} = \frac{\lambda_3}{(\lambda_3 - \lambda_1)} = 2.205 \qquad [12]$$

The ^{95}Zr and ^{95}Nb activity concentrations at the reference time were derived by using Equation 10 and the standardised values at 1 December 2004 (12:00 GMT). The ratio between ^{95}Nb and ^{95}Zr at the reference time was 2.0891(4). In order to take account of decay and ingrowth during acquisition the following equation was used to calculate the ^{95}Nb activity at the start of the acquisition.

$$A_3(r) = \frac{\lambda_3\, C_3\, (t_2 - t_1)}{\left(e^{-\lambda_3 t_1} - e^{-\lambda_3 t_2}\right)} - \frac{\lambda_3\, R_1}{\lambda_1}\frac{\left(e^{-\lambda_1 t_1} - e^{-\lambda_1 t_2}\right)}{\left(e^{-\lambda_3 t_1} - e^{-\lambda_3 t_2}\right)} - \frac{\lambda_3\, R_2}{\lambda_2}\frac{\left(e^{-\lambda_2 t_1} - e^{-\lambda_2 t_2}\right)}{\left(e^{-\lambda_3 t_1} - e^{-\lambda_3 t_2}\right)}$$

$$+ \quad (R_1 + R_2)$$

$$Where: \quad R_1 = \frac{\lambda_3\, A_1(r)}{(\lambda_3 - \lambda_1)}\left[1 - p + \frac{q\, p\, \lambda_2}{(\lambda_2 - \lambda_1)}\right]$$

and

$$R_2 = \frac{q\, \lambda_3}{(\lambda_3 - \lambda_2)}\left[A_2(r) - \frac{p\, \lambda_2\, A_1(r)}{(\lambda_2 - \lambda_1)}\right]$$

where:

$A_2(t)$	– ^{95m}Nb activity at time t	
r	– reference time:	1 October 2005 12:00 GMT
t_1	– start of the acquisition	
t_2	– end of the acquisition	
C_3	– reported ^{95}Nb activity	

3. RESULTS AND DISCUSSION

3.1 ABL and ABH samples

3.1.1 Iron-55

The main difficulty in measuring the ^{55}Fe activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample and the fact that ^{55}Fe emits only low-energy X rays (0.6 – 6.5 keV) and Auger electrons (0.5 – 6.5 keV).

Four results were reported for the ABL samples (see Figures 1A to 1D). Three results are in agreement with the assigned value, while one result is questionable. The reported results show a positive bias, although this is not significant. There is no indication that the detection method (liquid scintillation counting or semi conductor detector), nor the radiochemical separation technique (precipitation and ion-exchange chromatography) led to any significant differences between the results.

Reported **ABL** results:	4
In agreement with the assigned value:	3
Questionable results:	1
Discrepant from the assigned value:	0

Seven results were reported for the ABH samples (see Figures 8A to 8D). Six results are in agreement with the assigned value, while one result is questionable. The reported results show no bias. There is no indication that the detection method (liquid scintillation counting or semi conductor detector), the nature of the yield tracer (^{55}Fe (i.e., standard addition), ^{59}Fe or stable Fe) nor the radiochemical separation technique (extraction chromatography, precipitation combined with liquid-liquid extraction or ion-exchange chromatography) led to any significant differences between the results.

Reported **ABH** results:	7
In agreement with the assigned value:	6
Questionable result:	1
Discrepant from the assigned value:	0

3.1.2 Strontium-89

The main difficulty in measuring the ^{89}Sr activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample combined with presence of ^{90}Sr which may interfere with the measurement of ^{89}Sr. Several approaches can be adopted: decay and/or ingrowth counting, separation of ^{90}Y (the daughter of ^{90}Sr) followed by Cherenkov and LSC counting and/or spectral deconvolution.

Five results were reported for the ABL samples (see Figures 2A to 2D). Three results are in agreement with the assigned value, while one reported result is questionable. One result is discrepant. The reported results show a negative bias, although this is not significant. There is no indication that the detection method [liquid scintillation counting (Labs 56, 22M and 22E) or gas flow proportional counting (Labs 35 and 21)], the nature of the yield tracer [gamma emitter ^{85}Sr (Labs 22M and 22E) or stable Sr (Labs 56, 35 and 21)] nor the radiochemical separation technique [extraction chromatography (Labs 56, 35 and 22E), precipitation combined with liquid-liquid extraction (Lab 21) or disk filtration (Lab 22M)] led to any significant differences between the results.

Reported **ABL** results:	5
In agreement with the assigned value:	3
Questionable results:	1
Discrepant from the assigned value:	1

Six results were reported for the ABH samples (see Figures 9A to 9D). Three results are in agreement with the assigned value, while two results are questionable. One result is discrepant. The reported results show a negative bias, although this is not significant. There is no indication that the detection method [liquid scintillation counting (Labs 22M, 22E and 60) or Cherenkov counting (Labs 55, 38 and 32)], the nature of the yield tracer [^{85}Sr or stable Sr (Lab 32)], nor the radiochemical separation technique [extraction chromatography, precipitation (Lab 55) or disk filtration (Lab 22M)] led to any significant differences between the results.

Reported **ABH** results:	6
In agreement with the assigned value:	3
Questionable result:	2
Discrepant from the assigned value:	1

3.1.3 Strontium-90

The main difficulty in measuring the ^{90}Sr activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample, combined with presence of ^{89}Sr which may interfere with the measurement of ^{90}Sr. Again, several approaches can be adopted: decay and/or ingrowth counting, separation of ^{90}Y followed by Cherenkov and LSC counting and/or spectral deconvolution.

Thirteen results were reported for the ABL samples (see Figures 3A to 3D). Five results are in agreement with the assigned value, while three results are questionable. Five results are discrepant. The reported results show no bias. Most participants used LSC or Cherenkov counting to detect ^{90}Sr or its daughter ^{90}Y, while five participants (Labs 35, 25, 8, 29 and 21) used gas flow proportional counting. Most participants used ^{85}Sr as the yield tracer for ^{90}Sr, with the exception of Labs 56, 35 and 21 (stable Sr), Lab 25 (stable Y) and Lab 8 (no information). The most popular method to separate ^{90}Sr was extraction chromatography, with the exception of Labs 25, 29, 21 and 13 (variety of precipitation techniques), Lab 22M (disk filtration) and Labs 28 and 7 (ion-exchange chromatography). There is no indication that the detection method, the nature of the yield tracer nor the radiochemical separation technique led to any significant differences between the results. The participants who also did report ^{89}Sr values (Labs 56, 35, 22M, 22E and 21) did not obtain more accurate (or less accurate) results than the participants who did not.

Reported **ABL** results:	13
In agreement with the assigned value:	5
Questionable results:	3
Discrepant from the assigned value:	5

Thirteen results were reported for the ABH samples (see Figures 10A to 10D). Seven results are in agreement with the assigned value, while four results are questionable. Two results are discrepant. The reported results show a positive bias, although this is not significant. Most participnats used LSC or Cherenkov counting to detect ^{90}Sr or its daughter ^{90}Y, while three participants (Labs 49, 36 and 14) used gas flow proportional counting. Most participants used ^{85}Sr as the yield tracer for ^{90}Sr, with the exception of Labs 32 and 59 (stable Sr), Labs 49 and 14 (stable Y) and Labs 36 and 8 (no information). The most popular method to separate ^{90}Sr was extraction chromatography, with the exception of Labs 55 and 59 (precipitation techniques), Lab 22M (disk filtration) and Labs 28 and 7 (ion-exchange chromatography). Three participants did isolate only ^{90}Y (Labs 49, 36 and 14; all by liquid / liquid extraction) and determined the ^{90}Sr activity concentration indirectly. There is no indication that the detection method, the nature of the yield tracer nor the radiochemical separation technique led to any significant differences between the results. The participants who also did report ^{89}Sr values (Labs 22E, 22M, 38, 55, 32 and 60) did obtain lower and slightly more accurate results than the participants who did not.

Reported **ABH** results:	13
In agreement with the assigned value:	7
Questionable result:	4
Discrepant from the assigned value:	2

3.1.4 Uranium-238

Uranium-238 can be measured with three independent techniques: alpha spectrometry, gamma spectrometry and mass spectrometry. The main difficulty in measuring the ^{238}U activity concentration with alpha spectrometry is the need for a radiochemical separation from the other radionuclides present in the sample.

Fifteen results were reported for the ABL samples (see Figures 4A to 4D). Eleven results are in agreement with the assigned value, while four results are questionable. The reported results show no bias. Most participants used alpha spectrometry to determine ^{238}U, while three participants (Labs 47M, 34 and 8M) used mass spectrometry. Most participants who used alpha spectrometry as the detection method used ion-exchange chromatography to separate ^{238}U. Three participants (Labs 29, 22 and 56) used extraction chromatography. Most participants used ^{232}U as the yield tracer, while one participant (Lab 47A) used ^{236}U. There is no indication that there are significant differences between the various techniques used.

Reported **ABL** results:	15
In agreement with the assigned value:	11
Questionable results:	4
Discrepant from the assigned value:	0

Fourteen results were reported for the ABH samples (see Figures 11A to 11D). Twelve results are in agreement with the assigned value. Two results are discrepant. The reported results show no bias. Most participants used alpha spectrometry to determine ^{238}U, while two participants (Labs 55 and 8M) used mass spectrometry and two participants (Labs 21 and 4G) used gamma spectrometry. Most participants (who used alpha spectrometry as the detection method) used ion-exchange chromatography to separate ^{238}U. Three participants (Labs 60, 38 and 22) used extraction chromatography. Most participants used ^{232}U as the yield tracer, while one participant (Lab 47) used ^{236}U. There is no indication that there are significant differences between the various techniques used.

Reported **ABH** results:	14
In agreement with the assigned value:	12
Questionable result:	0
Discrepant from the assigned value:	2

3.1.5 Plutonium-238

The main difficulty in measuring the ^{238}Pu activity concentration with alpha spectrometry is the need for a radiochemical separation from the other radionuclides present in the sample (especially the ^{241}Am 5.44 MeV and 5.49 MeV peaks which interfere with the 5.46 MeV and 5.50 MeV peaks of ^{238}Pu). It is possible to determine ^{238}Pu with gamma spectrometry, although the emission probability for the 43 keV peak is only 0.0397(8)%.

Sixteen results were reported for the ABL samples (see Figures 5A to 5D). Thirteen results are in agreement with the assigned value, while one result is questionable. Two results are discrepant. The reported results show a negative bias, although this is not significant. All participants used alpha spectrometry to determine ^{238}Pu. Most participants used ion-exchange chromatography to separate ^{238}Pu. Two participants (Labs 56 and 47) used extraction chromatography. Three participants (Labs 25, 41 and 47) used ^{236}Pu as the yield tracer, while the other participants used ^{242}Pu. There is no indication that there are significant differences between the various techniques used.

Reported **ABL** results:	16
In agreement with the assigned value:	13
Questionable results:	1
Discrepant from the assigned value:	2

Fourteen results were reported for the ABH samples (see Figures 12A to 12D). Ten results are in agreement with the assigned value, while one result is questionable. Three results are discrepant. The reported results show a positive bias, although this is not significant. All but one participant used alpha spectrometry to determine ^{238}Pu. Lab 21 used gamma spectrometry (43 keV peak) which resulted in a discrepant result. Most participants who used alpha spectrometry as the detection method separated ^{238}Pu with ion-exchange chromatography. Three participants (Labs 47, 38 and 14) used extraction chromatograpy, while Lab 49 used liquid / liquid extraction (which resulted in a discrepant result). Two participants (Labs 47 and 32) used ^{236}Pu as the yield tracer, while the other participants used ^{242}Pu. There is no indication that there is a significant difference between the two yield tracers used.

Reported **ABH** results:	14
In agreement with the assigned value:	10
Questionable result:	1
Discrepant from the assigned value:	3

3.1.6 Plutonium-239

The main difficulty in measuring the ^{239}Pu activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample. Seventeen results were reported for the ABL samples (see Figures 6A to 6D). Fourteen results are in agreement with the assigned value. Three results are discrepant. The reported results show no bias. All participants used alpha spectrometry to determine ^{239}Pu. Most participants used ion-exchange chromatography to separate ^{239}Pu. Three participants (Labs 56, 47 and 26) used extraction chromatography. Three participants (Labs 25, 47 and 41) used ^{236}Pu as the yield tracer, while the other participants used ^{242}Pu. There is no indication that there are significant differences between the various techniques used.

Reported **ABL** results:	17
In agreement with the assigned value:	14
Questionable result:	0
Discrepant from the assigned value:	3

Thirteen results were reported for the ABH samples (see Figures 13A to 13D). Twelve results are in agreement with the assigned value. One result is discrepant. The reported results show no bias. All participants used alpha spectrometry to determine ^{239}Pu. Most participants used ion-exchange chromatography to separate ^{239}Pu. Three participants (Labs 14, 47 and 38) used extraction chromatography, while one particpant (Lab 49) used liquid / liquid extraction. Two participants (Labs 47 and 32) used ^{236}Pu as the yield tracer, while the other participants used ^{242}Pu. There is no indication that there are significant differences between the various techniques used (except for the liquid / liquid extraction technique used by Lab 49 which resulted in a discrepant result).

Reported **ABH** results:	13
In agreement with the assigned value:	12
Questionable result:	0
Discrepant from the assigned value:	1

3.1.7 Americium-241

Americium-241 can be measured with three independent techniques: alpha spectrometry, gamma spectrometry and mass spectrometry. The main difficulty in measuring the ^{241}Am activity concentration with alpha spectrometry is the need for a radiochemical separation from the other radionuclides present in the sample (especially the ^{238}Pu 5.46 MeV and 5.50 MeV peaks which interfere with the 5.44 MeV and 5.49 MeV peaks of ^{241}Am).

Fifteen results were reported for the ABL samples (see Figures 7A to 7D). Twelve results are in agreement with the assigned value, while one result is questionable. Two results are discrepant. The reported results show a positive bias, although this is not significant. The large majority of the participants used alpha spectrometry to determine ^{241}Am. Two participants (Labs 21 and 42) used gamma spectrometry. Most participants who used alpha spectrometry as the detection method separated ^{241}Am with ion-exchange chromatography. Three participants (Labs 47, 22 and 40) used extraction chromatograpy. One participant (Lab 26) did not separate ^{241}Am from interfering ^{238}Pu which resulted in a discrepant result.

Reported **ABL** results:	15
In agreement with the assigned value:	12
Questionable result:	1
Discrepant from the assigned value:	2

Seventeen results were reported for the ABH samples (see Figures 14A to 14D). Fourteen results are in agreement with the assigned value, while two results are questionable. One result is discrepant. The reported results show no bias. The majority of the participants used alpha spectrometry to determine ^{241}Am. Six participants (Labs 8X2, 8L, 8X1, 21, 55 and 4G) used gamma spectrometry. About half of the participants who used alpha spectrometry as the detection method separated ^{241}Am with ion-exchange chromatography. Five participants (Labs 14, 60, 38, 32 and 22) used extraction chromatograpy.

Reported **ABH** results:	17
In agreement with the assigned value:	14
Questionable result:	2
Discrepant from the assigned value:	1

3.2 GL and GH samples

The following nuclides were present in the samples and should have been reported. In case they were not reported by a participant, they were considered as a ‘missing result’.

3.2.1 Sodium-22

The main difficulty in measuring ^{22}Na is the need to correct for coincidence summing between the 511 keV and the 1275 keV peaks combined with the possibility of mistaking this nuclide for ^{154}Eu (which gives rise to a 1274 keV peak).

Thirty results were reported for the GL samples (see Figures 15A to 15D). Twenty-four results are in agreement with the assigned value, while five results are questionable. One result is discrepant. The reported results show a significant negative bias.

Reported **GL** results:	30
In agreement with the assigned value:	24
Questionable results:	5
Discrepant from the assigned value:	1
Missing results:	3

Thirty-three results were reported for the GH samples (see Figures 25A to 25D). Seventeen results are in agreement with the assigned value, while ten results are questionable. Six results are discrepant. The reported results show a significant negative bias.

Reported **GH** results:	33
In agreement with the assigned value:	17
Questionable results:	10
Discrepant from the assigned value:	6
Missing results:	2

3.2.2 Cobalt-60

There are no specific measurement problems for this nuclide.

Thirty-three results were reported for the GL samples (see Figures 16A to 16D). Twenty-six results are in agreement with the assigned value, while four results are questionable. Three results are discrepant. The reported results show no bias.

Reported **GL** results:	33
In agreement with the assigned value:	26
Questionable results:	4
Discrepant from the assigned value:	3
Missing results:	0

Thirty-five results were reported for the GH samples (see Figures 26A to 26D). Thirty-three results are in agreement with the assigned value, while two results are questionable. The reported results show no bias.

Reported **GH** results:	35
In agreement with the assigned value:	33
Questionable results:	2
Discrepant from the assigned value:	0
Missing results:	0

3.2.3 Yttrium-88

There are no specific measurement problems for this nuclide.

Thirty-one results were reported for the GL samples (see Figures 17A to 17D). Twenty-six results are in agreement with the assigned value, while two results are questionable. Three results are discrepant. The reported results show no bias.

Reported **GL** results:	31
In agreement with the assigned value:	26
Questionable results:	2
Discrepant from the assigned value:	3
Missing results:	2

Thirty-four results were reported for the GH samples (see Figures 27A to 27D). Thirty results are in agreement with the reference value, while four results are questionable. The reported results show no bias.

Reported **GH** results:	34
In agreement with the assigned value:	30
Questionable results:	4
Discrepant from the assigned value:	0
Missing results:	1

3.2.4 Zirconium-95

There are no specific measurement problems for this nuclide.

Twenty-seven results were reported for the GL samples (see Figures 18A to 18D). Twenty-two results are in agreement with the assigned value, while four results are questionable. One result is discrepant. The reported results show a positive bias, although this is not significant.

Reported **GL** results:	27
In agreement with the assigned value:	22
Questionable results:	4
Discrepant from the assigned value:	1
Missing results:	6

Thirty-five results were reported for the GH samples (see Figures 28A to 28D). Twenty-nine results are in agreement with the assigned value, while two results are questionable. Four results are discrepant. The reported results show no bias.

Reported **GH** results:	35
In agreement with the assigned value:	29
Questionable results:	2
Discrepant from the assigned value:	4
Missing results:	0

3.2.5 Niobium-95

The main difficulty in the determination of the ^{95}Nb activity concentration is the decay correction to the reference time and, to a lesser degree, the fact that the ^{95}Nb/^{95}Zr activity ratio increases during measurement combined with the need to use a modified form of the Bateman equations taking account of the multiple branching of the parents ^{95}Zr and ^{95m}Nb.

Twenty-eight results were reported for the GL samples (see Figures 19A to 19D). Fourteen results are in agreement with the assigned value, while four results are questionable. Ten results are discrepant. The reported results show a positive bias, although this is not significant.

Reported **GL** results:	28
In agreement with the assigned value:	14
Questionable results:	4
Discrepant from the assigned value:	10
Missing results:	5

Thirty results were reported for the GH samples (see Figures 29A to 29D). Twelve results are in agreement with the assigned value, while three results are questionable. Fifteen results are discrepant. The reported results show a positive bias, although this is not significant.

Reported **GH** results:	30
In agreement with the assigned value:	12
Questionable results:	3
Discrepant from the assigned value:	15
Missing results:	5

3.2.6 Antimony-125

The challenge in the measurement of this nuclide is the need for coincidence summing corrections.

Thirty-one results were reported for the GL samples (see Figures 20A to 20D). Twenty-five results are in agreement with the assigned value, while three results are questionable. Three results are discrepant. The reported results show no bias.

Reported **GL** results:	31
In agreement with the assigned value:	25
Questionable results:	3
Discrepant from the assigned value:	3
Missing results:	2

Thirty-five results were reported for the GH samples (see Figures 30A to 30D). Twenty-nine results are in agreement with the assigned value, while four results are questionable. Two results are discrepant. The reported results show no bias.

Reported **GH** results:	35
In agreement with the assigned value:	29
Questionable results:	4
Discrepant from the assigned value:	2
Missing results:	0

3.2.7 Barium-133

The challenge in the measurement of this nuclide is the need for coincidence summing corrections.

Thirty-two results were reported for the GL samples (see Figures 21A to 21D). Twenty-four results are in agreement with the assigned value, while six results are questionable. Two results are discrepant. The reported results show a negative bias, although this is not significant.

Reported **GL** results:	32
In agreement with the assigned value:	24
Questionable results:	6
Discrepant from the assigned value:	2
Missing results:	1

Thirty-four results were reported for the GH samples (see Figures 31A to 31D). Twenty-five results are in agreement with the assigned value, while two results are questionable. Seven results are discrepant. The reported results show a significant negative bias.

Reported **GH** results:	34
In agreement with the assigned value:	25
Questionable results:	2
Discrepant from the assigned value:	7
Missing results:	1

3.2.8 Caesium-134

The measurement of ^{134}Cs is complicated by the significant coincidence summing corrections needed.

Thirty-three results were reported for the GL samples (see Figures 22A to 22D). Twenty-seven results are in agreement with the assigned value, while three results are questionable. Three results are discrepant. The reported results show a negative bias, although this is not significant.

Reported **GL** results:	33
In agreement with the assigned value:	27
Questionable results:	3
Discrepant from the assigned value:	3
Missing results:	0

Thirty-five results were reported for the GH samples (see Figures 32A to 32D). Twenty-five results are in agreement with the assigned value, while five results are questionable. Five results are discrepant. The reported results show a significant negative bias.

Reported **GH** results:	35
In agreement with the assigned value:	25
Questionable results:	5
Discrepant from the assigned value:	5
Missing results:	0

3.2.9 Caesium-137

There are no specific measurement problems for this nuclide.

Thirty-two results were reported for the GL samples (see Figures 23A to 23D). Twenty-five results are in agreement with the assigned value, while five results are questionable. Two results are discrepant. The reported results show a positive bias, although this is not significant.

Reported **GL** results:	32
In agreement with the assigned value:	25
Questionable results:	5
Discrepant from the assigned value:	2
Missing results:	1

Thirty-five results were reported for the GH samples (see Figures 33A to 33D). Thirty-two results are in agreement with the assigned value, while two results are questionable. One result is discrepant. The reported results show no bias.

Reported **GH** results:	35
In agreement with the assigned value:	32
Questionable results:	2
Discrepant from the assigned value:	1
Missing results:	0

3.2.10 Europium-152

The challenge in the measurement of this nuclide is the need for coincidence summing corrections combined with the possibility of mistaking this nuclide for ^{57}Co (which also gives rise to a 122 keV peak).

Twenty-five results were reported for the GL samples (see Figures 24A to 24D). Sixteen results are in agreement with the assigned value, while six results are questionable. Three results are discrepant. The reported results show a negative bias, although this is not significant.

Reported **GL** results:	25
In agreement with the assigned value:	16
Questionable results:	6
Discrepant from the assigned value:	3
Missing results:	8

Thirty-two results were reported for the GH samples (see Figures 34A to 34D). Twenty-six results are in agreement with the assigned value, while three results are questionable. Three results are discrepant. The reported results show a significant negative bias.

Reported **GH** results:	32
In agreement with the assigned value:	26
Questionable results:	3
Discrepant from the assigned value:	3
Missing results:	3

3.3 LB samples

3.3.1 Hydrogen-3

The main difficulty in measuring the ^{3}H activity concentration is the need for a radiochemical separation from ^{14}C and ^{35}S, although this is easily done by distillation. Twenty-eight results were reported for this nuclide (see Figures 35A to 35D). Twenty-three results are in agreement with the assigned value, while three results are questionable. Two results are discrepant. The reported results show no bias. The large majority of the participants used distillation to separate tritium from ^{14}C and ^{35}S. Four participants submitted results for both distillation and sample combustion, while one participant (Lab 60) used a Tritium column (Eichrom) to separate tritium. There appears to be no significant differences between the various techniques used. All participants used liquid scintillation counting as the detection method.

Reported results:	28
In agreement with the assigned value:	23
Questionable results:	3
Discrepant from the assigned value:	2

3.3.2 Carbon-14

The main difficulty in measuring the ^{14}C activity concentration is the need for a radiochemical separation from ^{3}H and ^{35}S. Eleven results were reported for this nuclide (see Figures 36A to 36D). Six results are in agreement with the assigned value, while two results are questionable. Three results are discrepant. The reported results show a positive bias, although this is not significant. Seven participants (i.e., Labs 32, 5, 25, 49, 38, 35 and 55) used $[^{14}C]O_2$ gas generation (either by sample combustion or the addition of acid) as the separation techniques, which resulted in more accurate results than the techniques used by the other four participants (i.e., dual windows setting in LSC, $Y_2(CO_3)_3$ precipitation, subtraction of the ^{35}S activity and $BaCO_3$ precipitation, respectively). All participants used liquid scintillation counting as the detection method.

Reported results:	11
In agreement with the assigned value:	6
Questionable results:	2
Discrepant from the assigned value:	3

3.3.3 Sulphur-35

The main difficulty in measuring the ^{35}S activity concentration is the need for a radiochemical separation from ^{3}H and ^{14}C. Ten results were reported for this nuclide (see Figures 37A to 37D). Six results are in agreement with the assigned value. Four results are discrepant. The reported results show a negative bias, although this is not significant. Most participants precipitated ^{35}S as $BaSO_4$ after separating it from ^{3}H and ^{14}C with either ion-exchange chromatogaphy or acidification/distillation of the sample. Two participants (Labs 34 and 48) who used another technique (i.e., $Y_2(CO_3)_3$ precipitation and dual windows setting in LSC, respectively) obtained discrepant results. All participants used liquid scintillation counting as the detection method.

Reported results:	10
In agreement with the assigned value:	6
Questionable results:	0
Discrepant from the assigned value:	4

3.4 Result summary

The combined results for all samples are listed in Tables 3.1 to 3.5. In total, 72% of the results were ‘in agreement’, 12% of the results were ‘questionable’, 12% of the results were ‘discrepant’ and 4% of the results were ‘missing’ [100% is represented by 898 results].

Table 3.1 – Results ABL

Nuclide	In agreement	Questionable	Discrepant
^{55}Fe	3	1	0
^{89}Sr	3	1	1
^{90}Sr	5	3	5
^{238}U	11	4	0
^{238}Pu	13	1	2
^{239}Pu	14	0	3
^{241}Am	12	1	2
Total	**61**	**11**	**13**
Total (%)	72	13	15

Table 3.2 – Results ABH

Nuclide	In agreement	Questionable	Discrepant
^{55}Fe	6	1	0
^{89}Sr	3	2	1
^{90}Sr	7	4	2
^{238}U	12	0	2
^{238}Pu	10	1	3
^{239}Pu	12	0	1
^{241}Am	14	2	1
Total	**64**	**10**	**10**
Total (%)	76	12	12

Table 3.3 – Results GL

Nuclide	In agreement	Questionable	Discrepant	Missing
^{22}Na	24	5	1	3
^{60}Co	26	4	3	0
^{88}Y	26	2	3	2
^{95}Zr	22	4	1	6
^{95}Nb	14	4	10	5
^{125}Sb	25	3	3	2
^{133}Ba	24	6	2	1
^{134}Cs	27	3	3	0
^{137}Cs	25	5	2	1
^{152}Eu	16	6	3	8
Total	**229**	**42**	**31**	**28**
Total (%)	69	13	9	8

Table 3.4 – Results GH

Nuclide	In agreement	Questionable	Discrepant	Missing
^{22}Na	17	10	6	2
^{60}Co	33	2	0	0
^{88}Y	30	4	0	1
^{95}Zr	29	2	4	0
^{95}Nb	12	3	15	5
^{125}Sb	29	4	2	0
^{133}Ba	25	2	7	1
^{134}Cs	25	5	5	0
^{137}Cs	32	2	1	0
^{152}Eu	26	3	3	3
Total	**258**	**37**	**43**	**12**
Total (%)	74	11	12	3

Table 3.5 – Results LB

Nuclide	In agreement	Questionable	Discrepant
^{3}H	23	3	2
^{14}C	6	2	3
^{35}S	6	0	4
Total	**35**	**5**	**9**
Total (%)	71	10	18

3.5 False positive identifications

Cobalt-57 (five GL results and one GH result), ^{113}Sn (one GL result) and ^{154}Eu (one GL result and two GH results) were reported. Cobalt-57 and ^{113}Sn were not present in the sample, while only a negligible activity of ^{154}Eu was present as an impurity [i.e., 0.0127(20) Bq kg^{-1} in the GL samples and 0.0072(11) Bq g^{-1} in the GH samples].

3.6 Analysis of results by participant

The combined results for each participant are presented in Table 3.6. The individual deviation results are presented in Figures 58 to 72.

Table 3.6 – Individual results

Participant	Results in agreement	Questionable results	Discrepannt results	Missing results
4	13 (42%)	6 (19%)	4 (13%)	8 (26%)
5	15 (65%)	2 (9%)	4 (17%)	2 (9%)
7	8 (33%)	5 (21%)	5 (21%)	6 (25%)
8	28 (76%)	5 (14%)	4 (11%)	0
9	11 (85%)	0	2 (15%)	0
10	15 (75%)	3 (15%)	2 (10%)	0
13	20 (77%)	1 (4%)	5 (19%)	0
14	9 (64%)	2 (14%)	2 (14%)	1 (7%)
15	10 (50%)	5 (25%)	1 (5%)	4 (20%)
17	21 (72%)	3 (10%)	2 (7%)	3 (10%)
18	18 (90%)	2 (10%)	0	0
19	7 (54%)	3 (23%)	3 (23%)	0
21	26 (90%)	1 (3%)	2 (7%)	0
22	14 (82%)	2 (12%)	1 (6%)	0
23	1 (10%)	0	9 (90%)	0
24	18 (90%)	0	0	2 (10%)
25	13 (72%)	2 (11%)	3 (17%)	0

Participant	Results in agreement	Questionable results	Discrepannt results	Missing results
26	8 (67%)	1 (8%)	3 (25%)	0
27	4 (20%)	14 (70%)	2 (10%)	0
28	26 (79%)	3 (9%)	3 (9%)	1 (3%)
29	15 (94%)	1 (6%)	0	0
32	20 (100%)	0	0	0
34	15 (83%)	0	2 (11%)	1 (6%)
35	24 (83%)	1 (3%)	3 (10%)	1 (3%)
36	9 (75%)	2 (17%)	1 (8%)	0
38	17 (85%)	2 (10%)	1 (5%)	0
40	10 (63%)	5 (31%)	0	1 (6%)
41	8 (57%)	4 (29%)	0	2 (14%)
42	10 (91%)	0	0	1 (9%)
45	8 (80%)	1 (10%)	0	1 (10%)
46	19 (90%)	0	0	2 (10%)
47	28 (97%)	1 (3%)	0	0
48	2 (17%)	4 (33%)	6 (50%)	0
49	10 (67%)	1 (7%)	4 (27%)	0
50	10 (100%)	0	0	0
51	10 (100%)	0	0	0
52	18 (90%)	0	2 (10%)	0
53	18 (90%)	0	2 (10%)	0
54	13 (65%)	2 (10%)	3 (15%)	2 (10%)
55	18 (90%)	2 (10%)	0	0
56	12 (75%)	1 (6%)	3 (19%)	0
57	2 (20%)	6 (60%)	1 (10%)	1 (10%)
58	1 (10%)	4 (40%)	5 (50%)	0
59	14 (88%)	0	2 (12%)	0
60	18 (95%)	1 (5%)	0	0
61	7 (35%)	6 (30%)	7 (35%)	0
62	9 (60%)	0	5 (33%)	1 (7%)
63	8 (80%)	1 (10%)	1 (10%)	0
64	9 (90%)	0	1 (10%)	0
Total	**647 (72%)**	**105 (12%)**	**106 (12%)**	**40 (4%)**

3.7 Mean and median values participants

The unweighted means and 99% confidence intervals for the participants' deviation results were calculated after exclusion of outliers. Two-sided Dixon's Q outlier tests (see Table F2; Appendix F) were used to determine whether a deviation was significantly different from the other results in the data set, resulting in the exclusion of twenty deviation results (2% of the total). The median of the deviations was calculated as well (see Table 3.7).

The mean deviations for ^{22}Na (GL and GH), ^{133}Ba (GH), ^{134}Cs (GH) and ^{152}Eu (GH) are significantly lower than zero, which indicates a significant difference between the participants results and the assigned value. The overall unweighted means deviation is (0.1 ± 4.0)%. The medians of the deviations ranges from –10% to 13% (18 negative and 19 positive values), with most values (i.e., 29) within ± 5% of the assigned value.

Table 3.7 – Mean deviation and median

Nuclide	Mean deviation ± 99% confid. limit (%)	Median (%)	Number of results	Number of outliers
^{55}Fe (ABL)	10 ± 29	13	4	0
^{89}Sr	–27 ± 71	–10	5	0
^{90}Sr	1 ± 39	–4.9	13	0
^{238}U	–0.5 ± 7.3	–2.6	15	0
^{238}Pu	–4.6 ± 7.5	–3.2	16	0
^{239}Pu	0.5 ± 2.8	–0.3	17	3
^{241}Am	3.5 ± 3.8	1.8	15	2
^{55}Fe (ABH)	–1 ± 20	1.9	7	0
^{89}Sr	–8 ± 27	–6.4	6	0
^{90}Sr	3 ± 11	0.1	13	1
^{238}U	–1.5 ± 6.0	–2.7	14	0
^{238}Pu	5 ± 10	2.6	14	2
^{239}Pu	–2 ± 10	–1.3	13	0
^{241}Am	2.7 ± 4.2	1.1	17	1
^{22}Na (GL)	–7.6 ± 4.5	–10	30	1
^{60}Co	–0.7 ± 3.5	0.3	33	1
^{88}Y	–0.6 ± 6.0	1.5	31	0
^{95}Zr	5 ± 12	4.0	27	1
^{95}Nb	24 ± 28	8.9	28	0
^{125}Sb	0.5 ± 7.5	3.4	31	0
^{133}Ba	–5.0 ± 6.7	–6.0	32	0

Nuclide	Mean deviation ± 99% confid. limit (%)	Median (%)	Number of results	Number of outliers
^{134}Cs	–4.1 ± 5.7	–3.8	33	0
^{137}Cs	3.0 ± 6.5	4.0	32	0
^{152}Eu	–8 ± 11	–5.3	25	0
^{22}Na (GH)	–6.8 ± 3.1	–7.5	33	1
^{60}Co	0.2 ± 1.7	0.1	35	0
^{88}Y	0.7 ± 1.9	0.5	34	0
^{95}Zr	1.4 ± 2.5	2.9	35	4
^{95}Nb	22 ± 22	3.2	30	0
^{125}Sb	–1.7 ± 2.8	–1.4	35	0
^{133}Ba	–5.1 ± 4.2	–2.6	34	1
^{134}Cs	–4.6 ± 3.5	–2.0	35	1
^{137}Cs	0.8 ± 2.2	1.8	35	1
^{152}Eu	–3.6 ± 3.0	–1.7	32	0
^{3}H (LB)	0.6 ± 3.5	0.5	28	0
^{14}C	21 ± 50	3.2	11	0
^{35}S	–11 ± 18	–4.3	10	0
Total	0.1 ± 4.0		856	20

3.8 Standard deviations for proficiency assessment and relative uncertainty outliers

The median relative uncertainties R_{med} and the outlier limit R_{lim} are listed in Table 3.8. R_{med} was used to calculate the standard uncertainty for proficiency assessment σ_{p} and the z-score for each result. R_{med} ranged from to 3.7% to 14%, but in general was in the order of 6%. One-sided Dixon's Q outlier tests (see Table F1; Appendix F) were used to determine whether a relative uncertainty was significantly different from the other results in the data set, resulting in the exclusion of twenty-one relative uncertainty results (2% of the total). For fourteen results this meant that, although they passed both the zeta test and z-test, the failure to pass the R_{lim} test resulted in a 'questionable' classification (these results are very close to the assigned value, but have an unacceptably large u_{L}). The other seven results were already classified as 'questionable', because they failed the z-test as well. R_{lim}, which is used to defines the "upper" limit in the Kiri plots, ranged from 12% to 72%.

Table 3.8 – Relative uncertainties of the lab values

Nuclide	Number of results	Median relative uncertainty R_{med} (%)	Number of outliers	Outlier limit R_{lim} (%)
^{55}Fe (ABL)	4	8.6	1	30
^{89}Sr	5	12	0	53
^{90}Sr	13	8.0	1	22
^{238}U	15	6.6	1	20
^{238}Pu	16	5.0	0	14
^{239}Pu	17	4.6	0	12
^{241}Am	15	5.0	0	15
^{55}Fe (ABH)	7	7.7	0	21
^{89}Sr	6	9.5	0	24
^{90}Sr	13	7.2	1	20
^{238}U	14	4.5	0	19
^{238}Pu	14	5.3	0	20
^{239}Pu	13	5.4	0	17
^{241}Am	17	5.1	0	17
^{22}Na (GL)	30	8.7	1	26
^{60}Co	33	4.5	0	25
^{88}Y	31	7.4	0	38
^{95}Zr	27	14	1	72
^{95}Nb	28	13	0	43
^{125}Sb	31	7.5	0	42
^{133}Ba	32	6.5	0	37
^{134}Cs	33	5.8	0	34
^{137}Cs	32	7.0	0	50
^{152}Eu	25	8.2	0	36
^{22}Na (GH)	33	3.8	2	18
^{60}Co	34	4.1	1	18
^{88}Y	35	3.7	1	16
^{95}Zr	35	4.8	2	16
^{95}Nb	30	5.0	2	16
^{125}Sb	35	4.1	1	16
^{133}Ba	34	4.7	1	16
^{134}Cs	35	4.1	1	16
^{137}Cs	35	3.8	1	17
^{152}Eu	32	4.4	1	19

Nuclide	Number of results	Median relative uncertainty R_{med} (%)	Number of outliers	Outlier limit R_{lim} (%)
^{3}H (LB)	28	4.7	1	22
^{14}C	11	7.9	1	35
^{35}S	10	6.7	0	22
Mean		6.4 ± 1.1		26 ± 6
Median		5.4		20

4. CONCLUSION

This proficiency test exercise was successfully completed, with all but two of the laboratories returning data. All 48 data sets were submitted electronically. Most participants were able to identify all the nuclides in the GL and GH sources. The number of 'false positives' results was 10. More than one result was returned for ^{57}Co and ^{154}Eu (reported by 4 and 2 participants, respectively).

For the ABL and ABH samples, 72% and 76%, respectively, of the results were 'in agreement'. In both cases, the most problematic nuclides were ^{89}Sr and ^{90}Sr. For the GL and GH samples, 69% and 74% of the results were 'in agreement', The most problematic nuclides were ^{22}Na, ^{95}Nb, ^{133}Ba ^{134}Cs and ^{152}Eu. There was a significant negative bias between the assigned result and the participants results for ^{22}Na, ^{133}Ba, ^{134}Cs and ^{152}Eu. Coincidence summing has been discussed in previous exercises, and is a problem for some of the nuclides included in this exercise (i.e., ^{22}Na, ^{60}Co, ^{88}Y, ^{125}Sb, ^{133}Ba, ^{134}Cs and ^{152}Eu). Coincidence summing leads to signal loss and hence underestimation of the activity levels of these nuclides. It is clear from the results that some participants do not make corrections for coincidence summing. Less than half of the returned results for ^{95}Nb were 'in agreement', with a third of the deviations exceeding 40%. It is clear that the use of incorrect decay corrections is responsible for this disappointing result. For the LB samples, 71% of the results were 'in agreement'. The most problematic nuclides were ^{14}C and ^{35}S.

5. FIGURES

Figures 1 to 37

A — Deviations D for results 'in agreement' are represented by the dark blue points. Questionable and discrepant results are represented by the yellow and red points, respectively. The error bars represent the standard uncertainties u_D (with a coverage factor of k=1). The black dotted lines represent deviations corresponding to the assigned value N plus or minus 2.58 times the assigned value uncertainty u_N. Thus, a laboratory value $L = N + 2.58\ u_N$ results in a deviation $D = 100\ (2.58\ u_N / N)$ %; the corresponding zeta score is ≤ 2.58 by definition. The light blue lines represent z-scores of –2.58 and 2.58.

B — The individual zeta score values are represented by the light blue bars.

C — The relative uncertainties of the laboratory values R_L that are not outliers are represented by the light blue bars. Relative uncertainties R_L that are outliers are represented by the yellow bars. The dotted line represents the outlier limit R_{lim}.

D — Kiri plots were contructed by plotting the squared ratio between the laboratory uncertainty u_L and the standard uncertainty for proficiency assessment σ_p against the z-scores. Data points that are in agreement are represented by the dark blue points. Questionable data points are represented by the yellow points. Discrepant data points are represented by the red points.

Figure 38 — The unweighted means of the deviations are represented by the dark blue points. The error bars represent the 99% confidence interval. The dotted blue lines represent the overall unweighted mean of all unweighted means and its 99% confidence interval.

Figure 39 — The medians of the deviations are represented by the the dark blue points.

Figure 40 — The medians of the relative uncertainties of the laboratory values R_{med} are represented by the dark blue points. The outlier limits for the relative uncertainties R_{lim} are represented by the light blue bars.

Figures 41 to 89 — Deviations D for results 'in agreement' are represented by the dark blue points. Questionable and discrepant results are represented by the yellow and red points, respectively. The error bars represent the standard uncertainties u_D (with a coverage factor of k=1).

Figure 1A – Deviation Fe-55 ABL

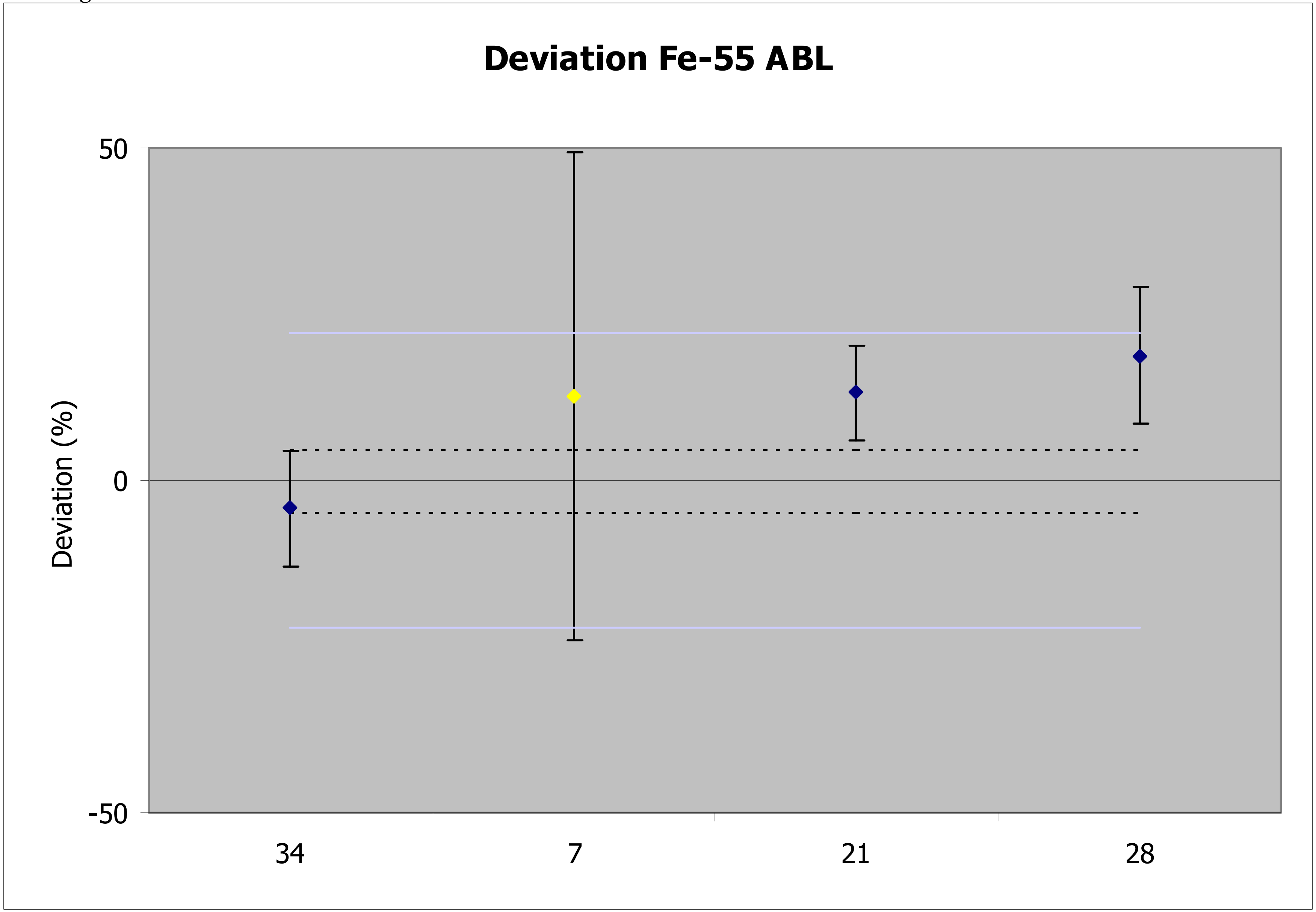


Figure 1B – Zeta score Fe-55 ABL

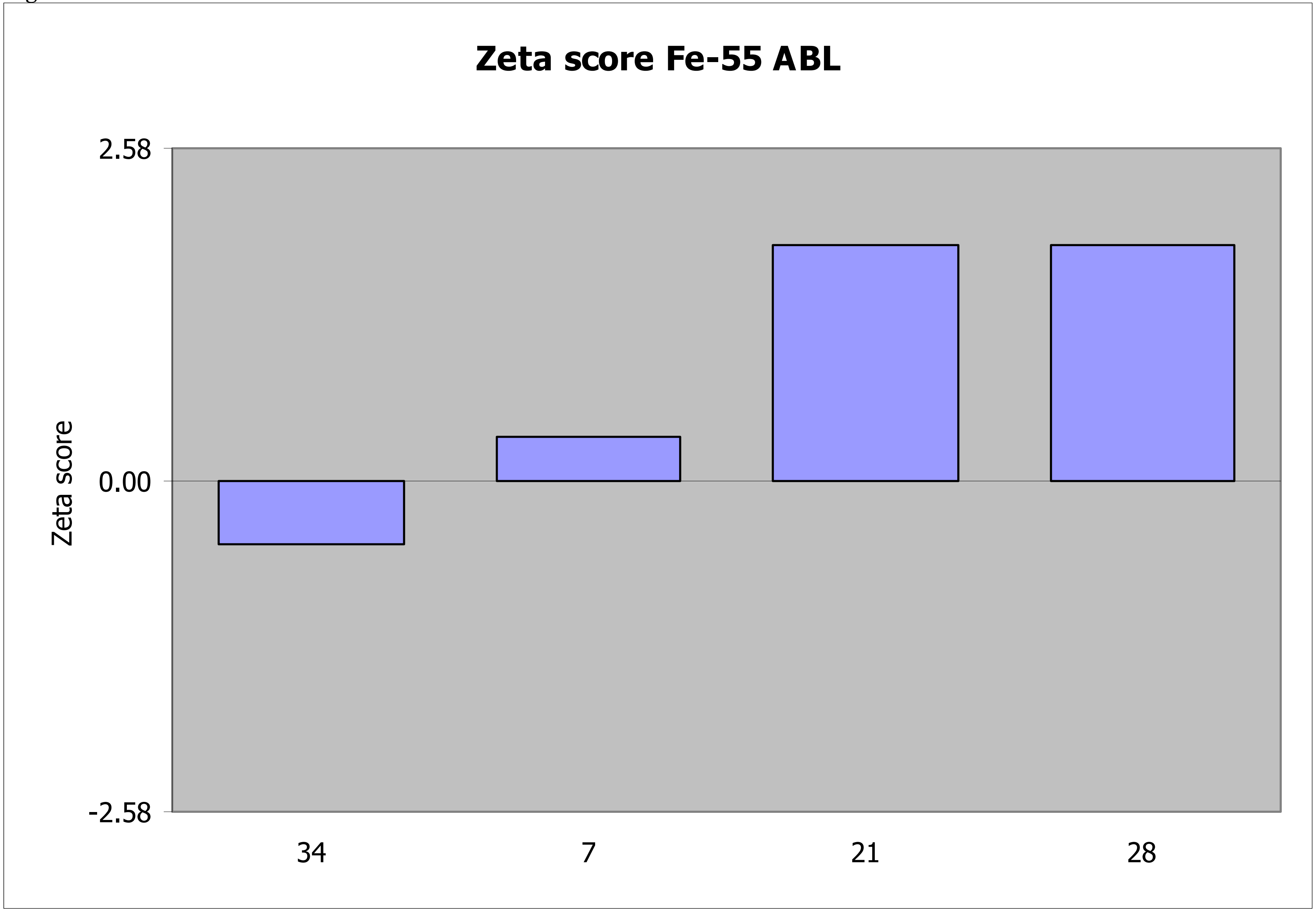


Figure 1C – Relative uncertainty Fe-55 ABL

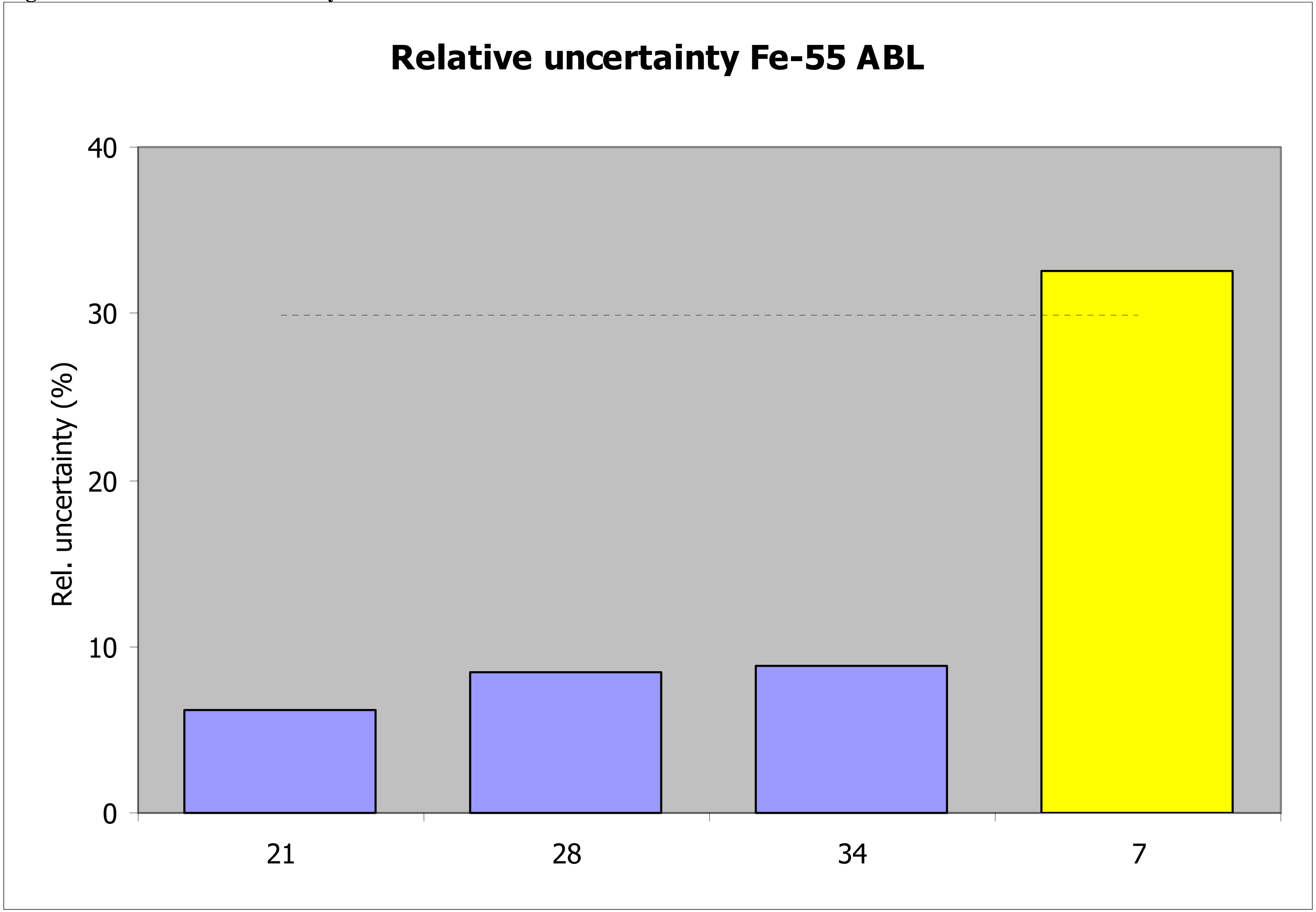


Figure 1D – Kiri plot Fe-55 ABL

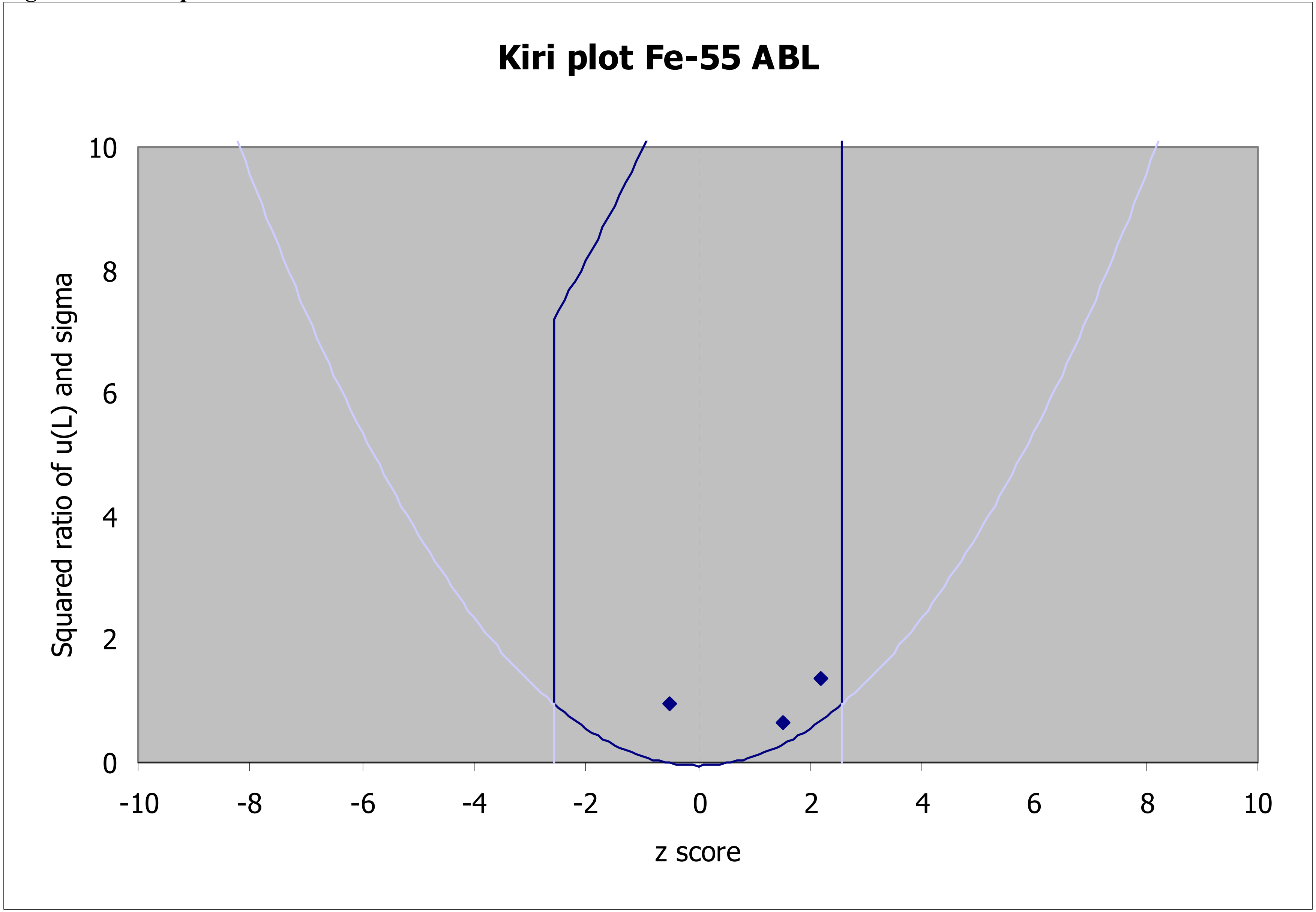


Figure 2A – Deviation Sr-89 ABL

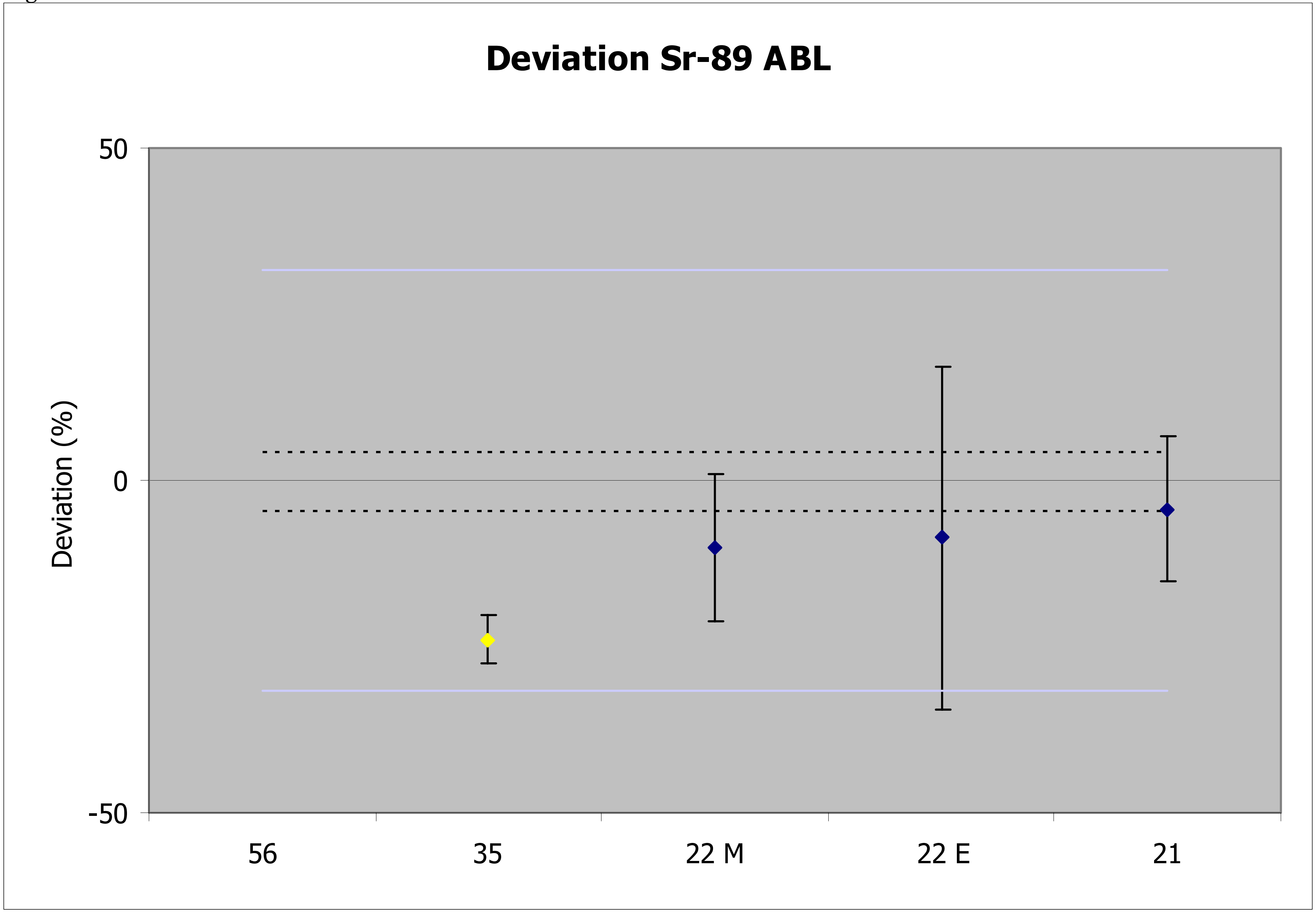


Figure 2B – Zeta score Sr-89 ABL

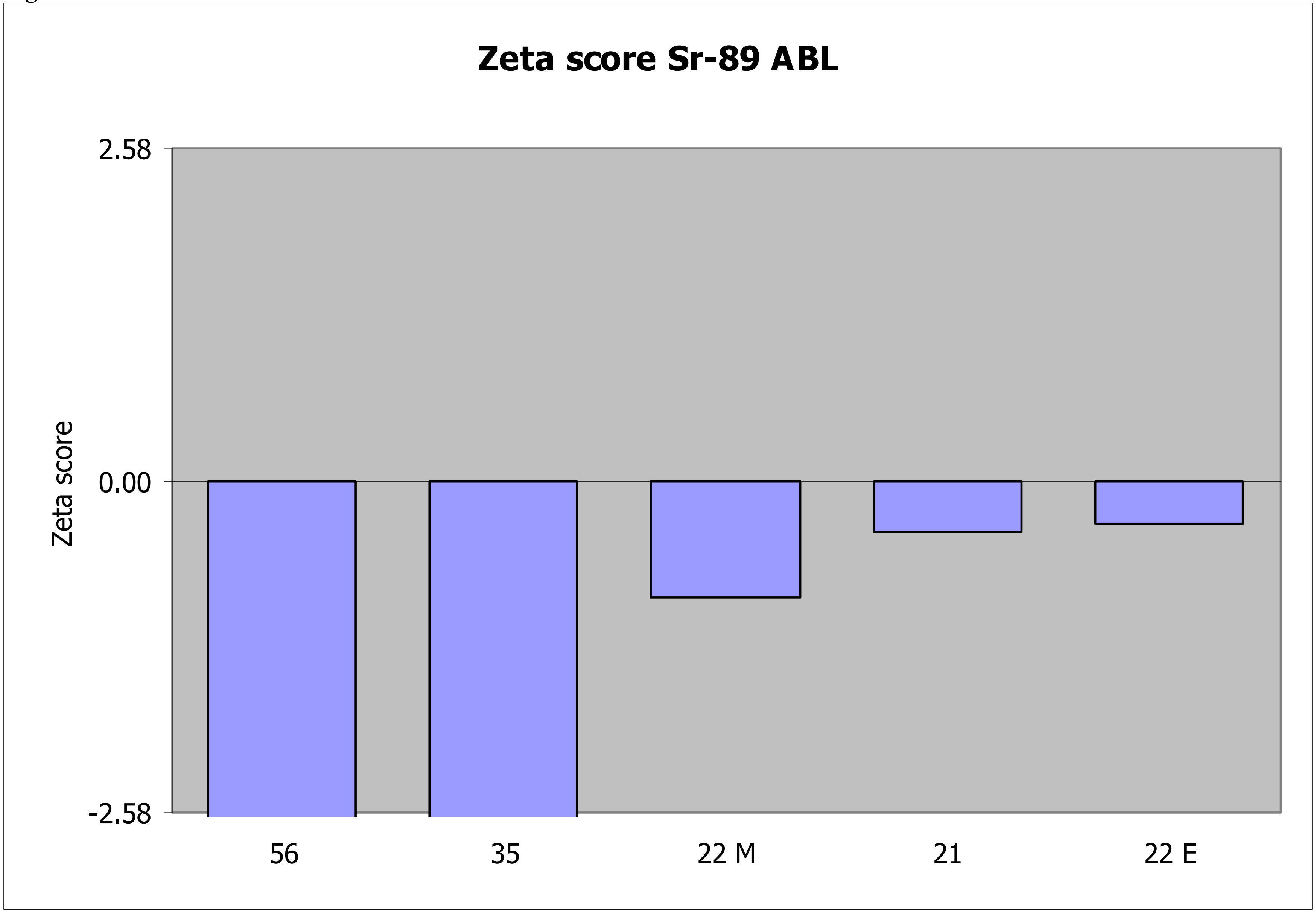


Figure 2C – Relative uncertainty Sr-89 ABL

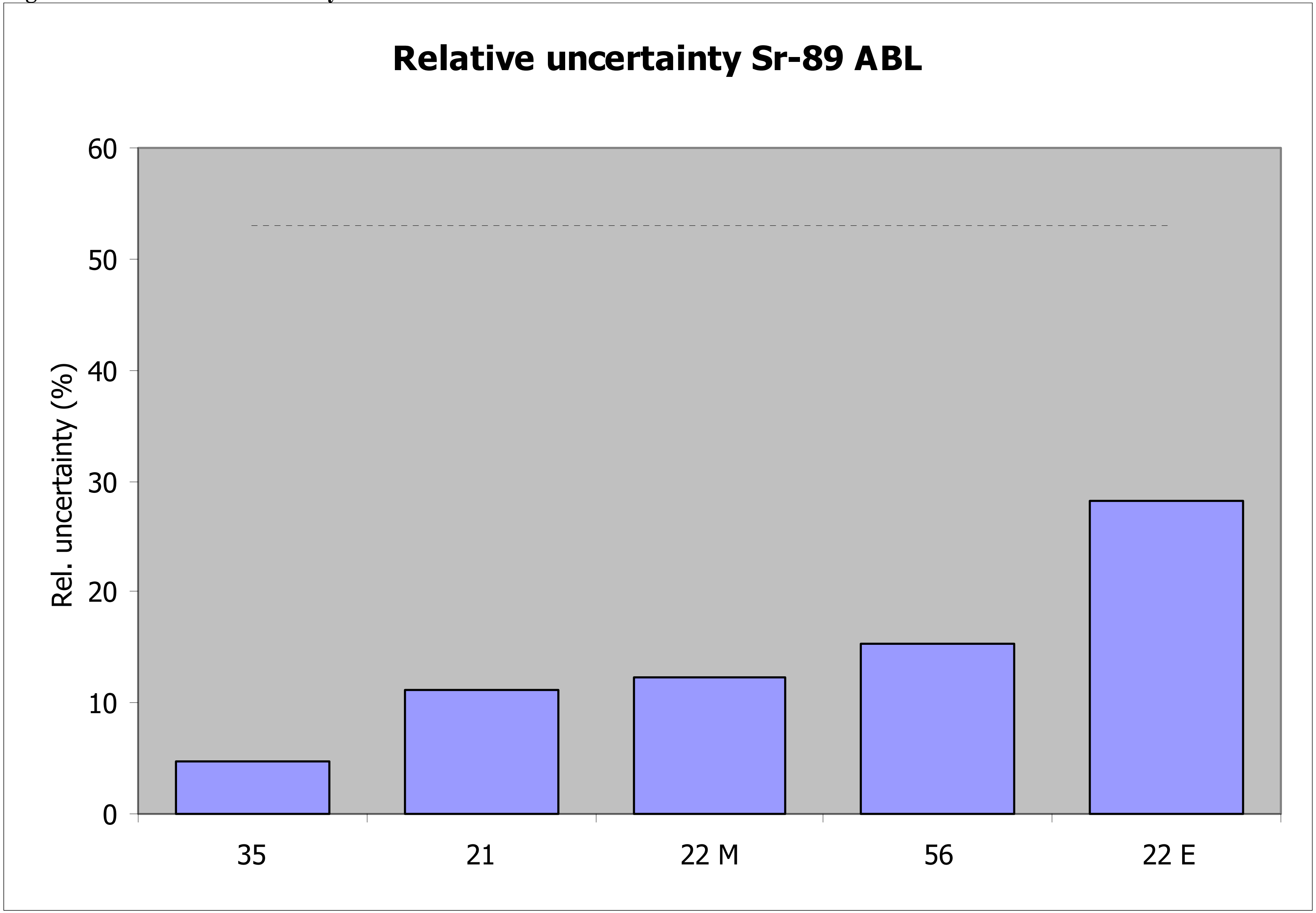


Figure 2D – Kiri plot Sr-89 ABL

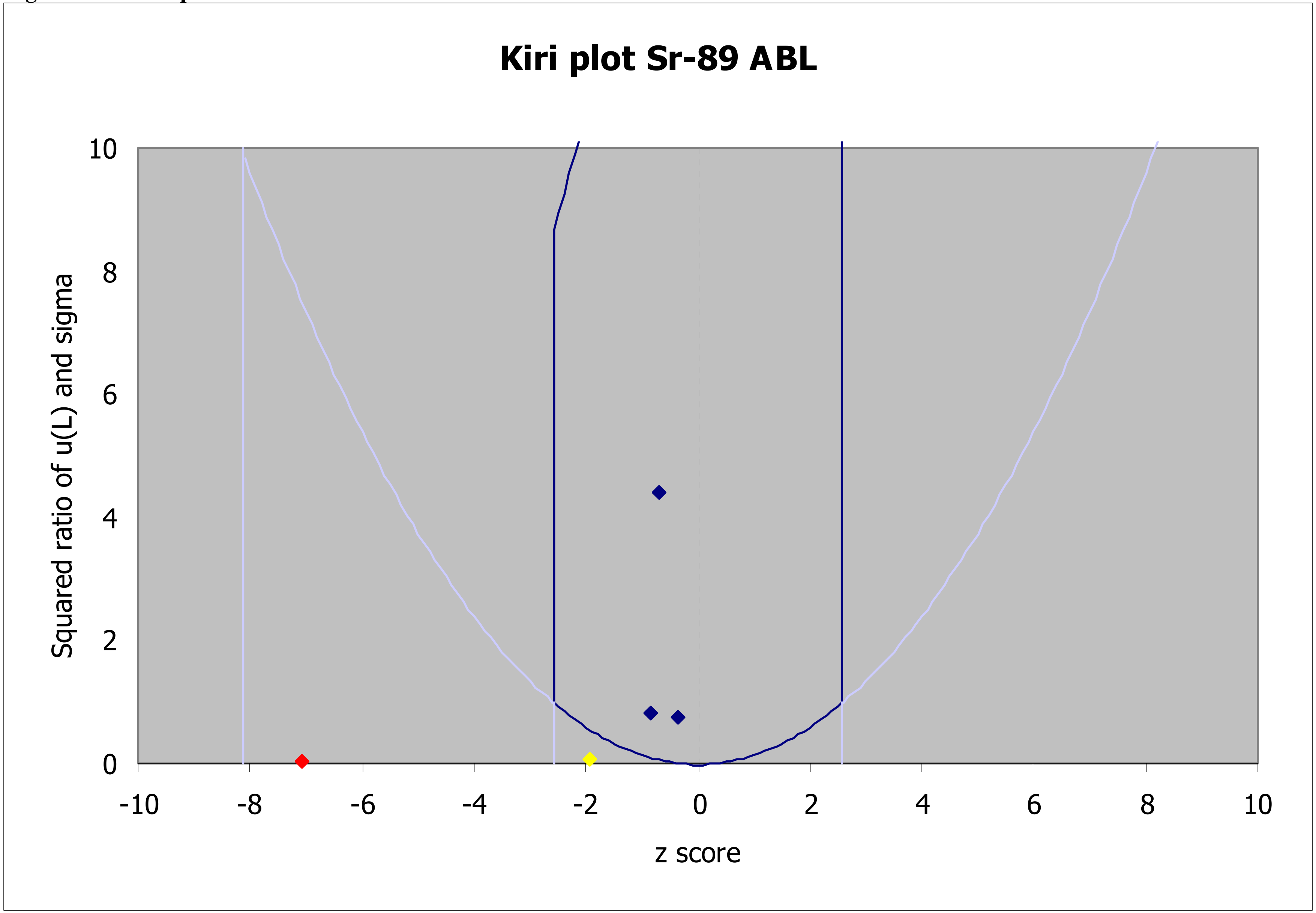


Figure 3A – Deviation Sr-90 ABL

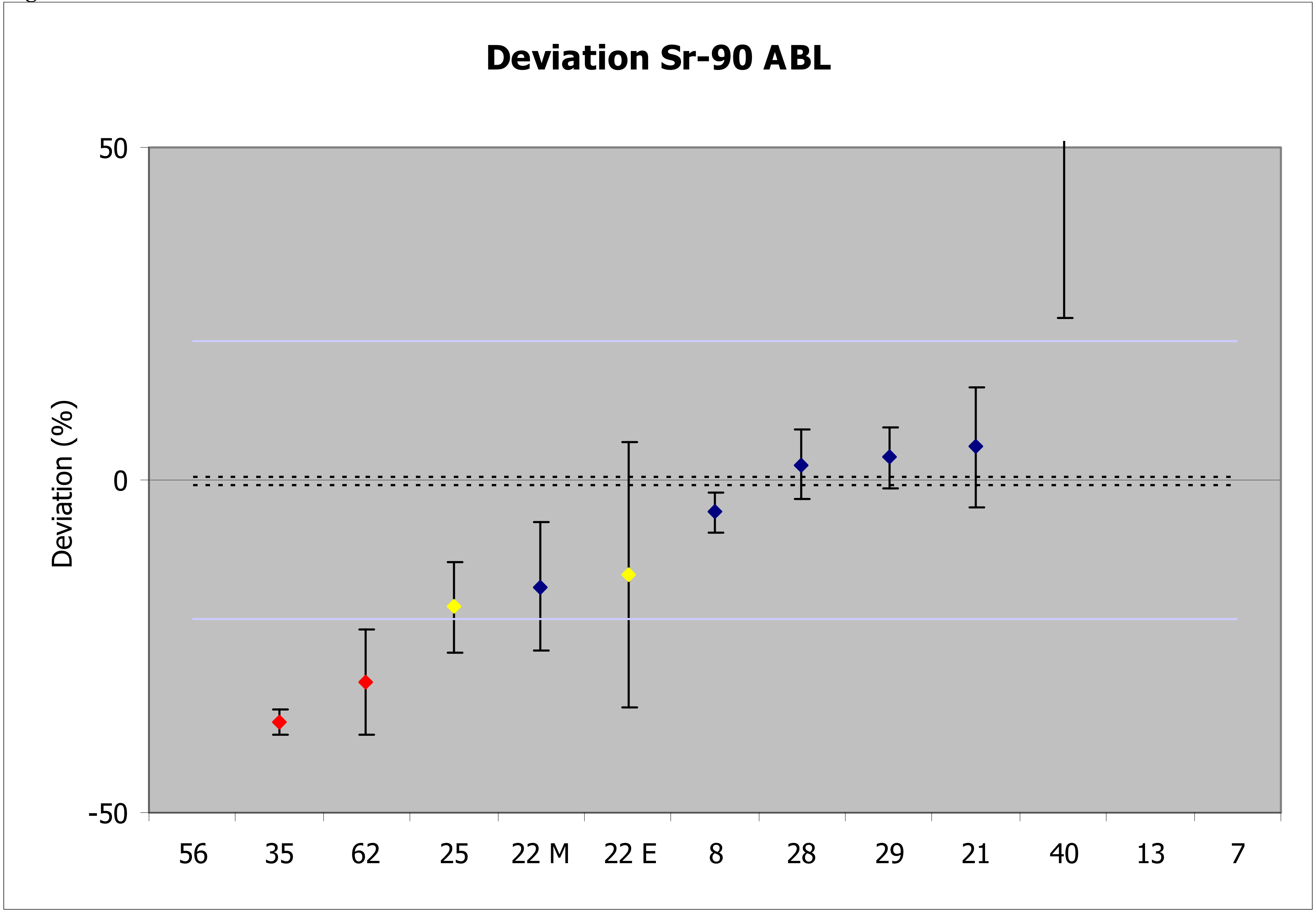


Figure 3B – Zeta score Sr-90 ABL

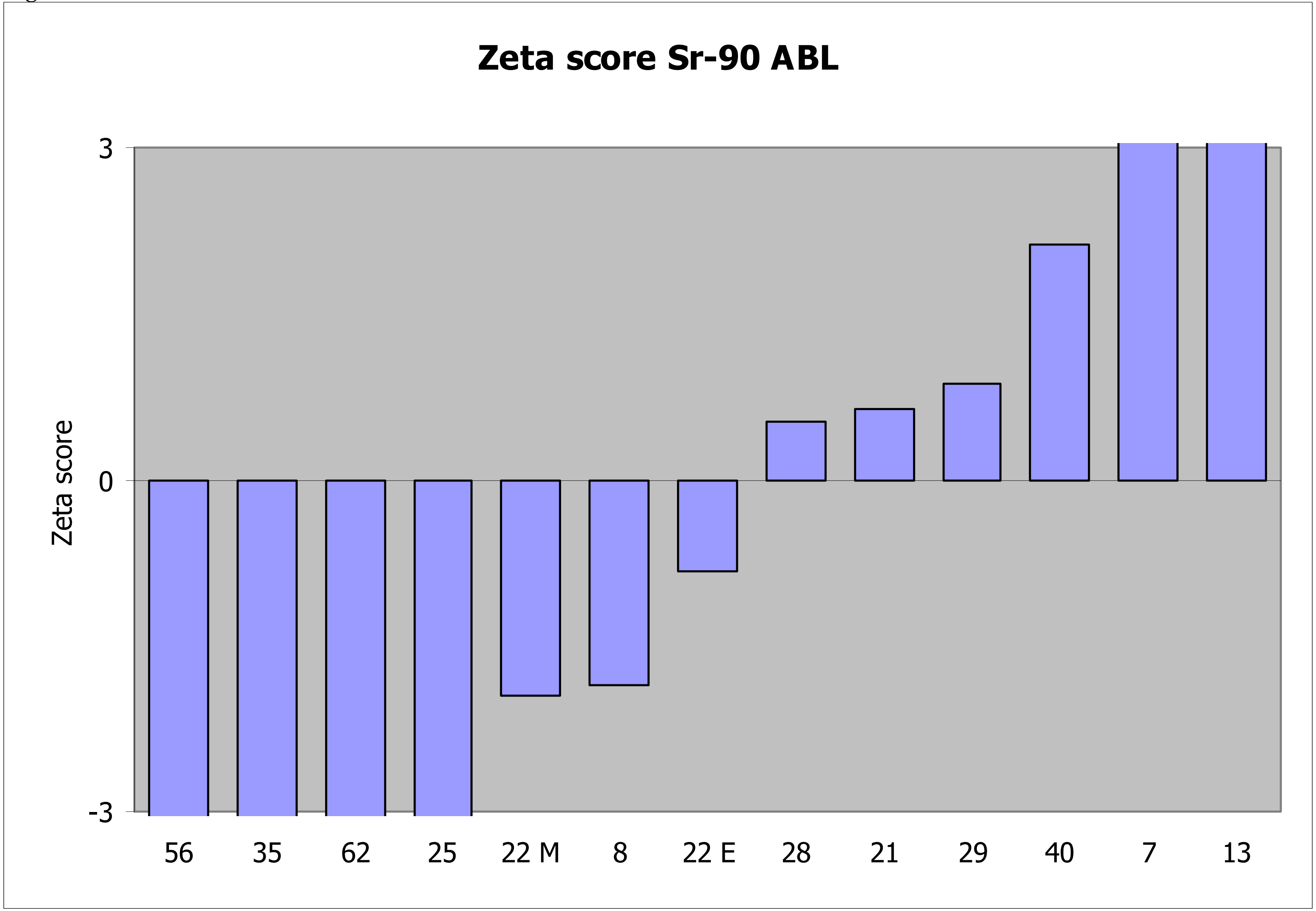


Figure 3C – Relative uncertainty Sr-90 ABL

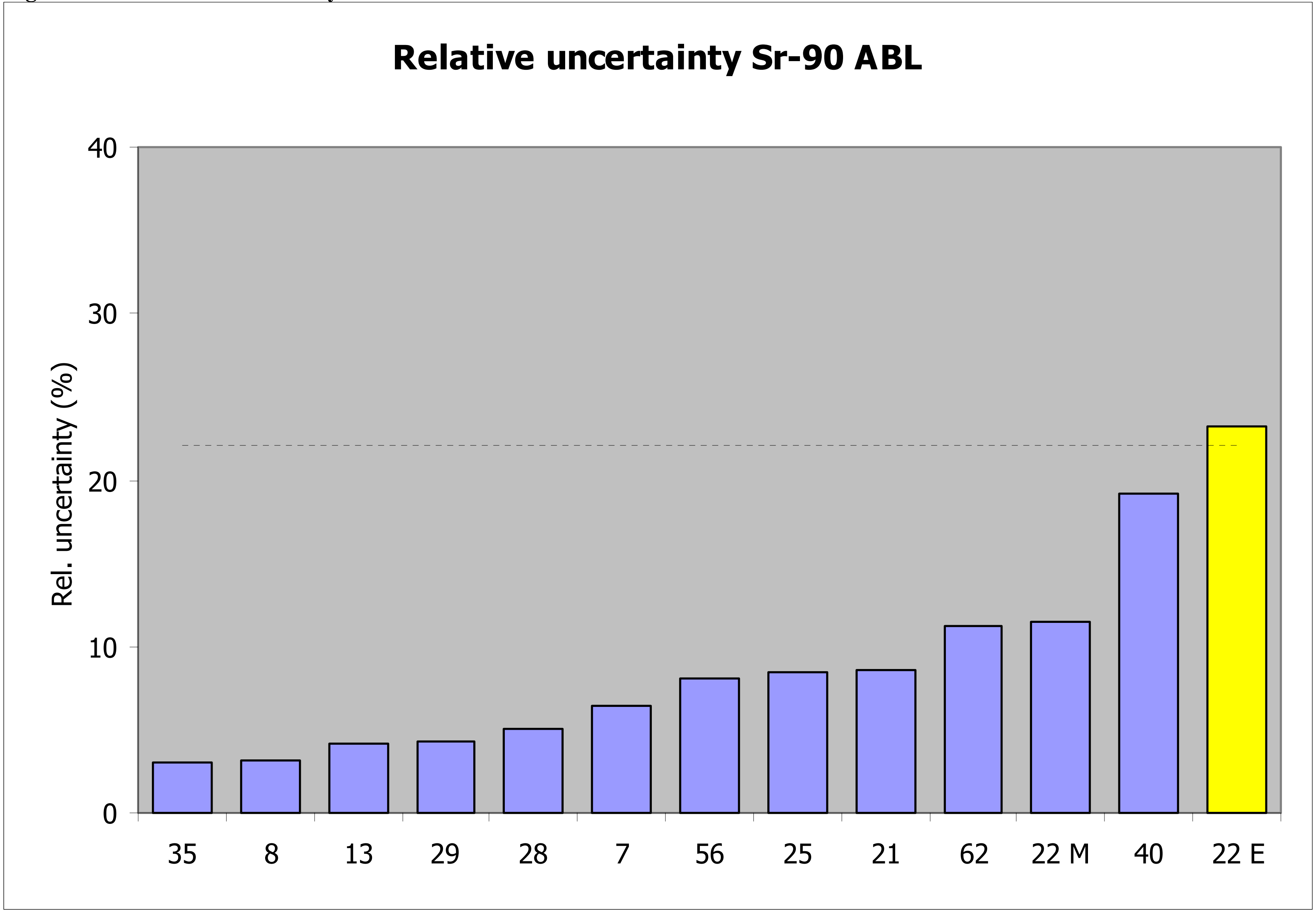


Figure 3D – Kiri plot Sr-90 ABL

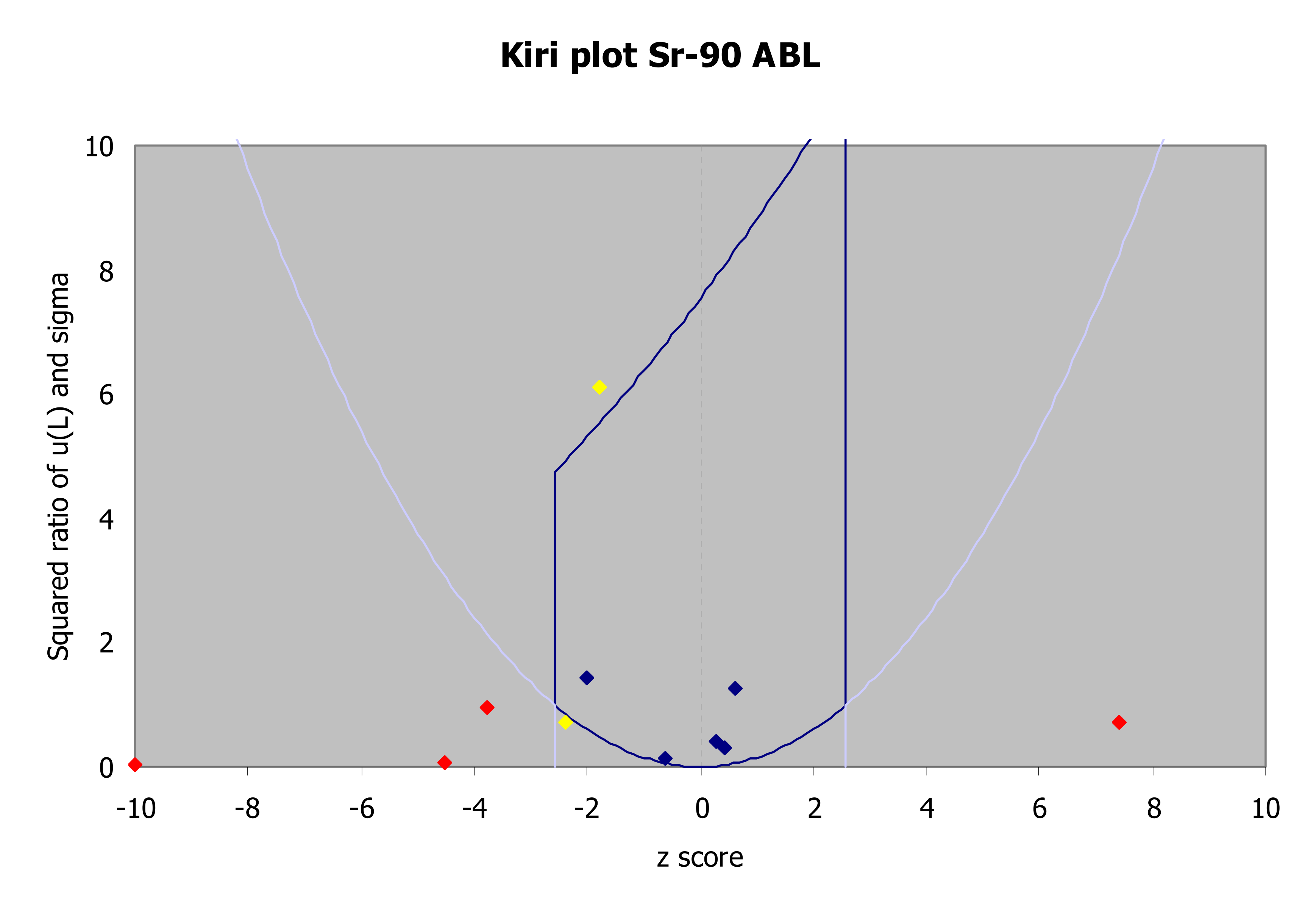


Figure 4A – Deviation U-238 ABL

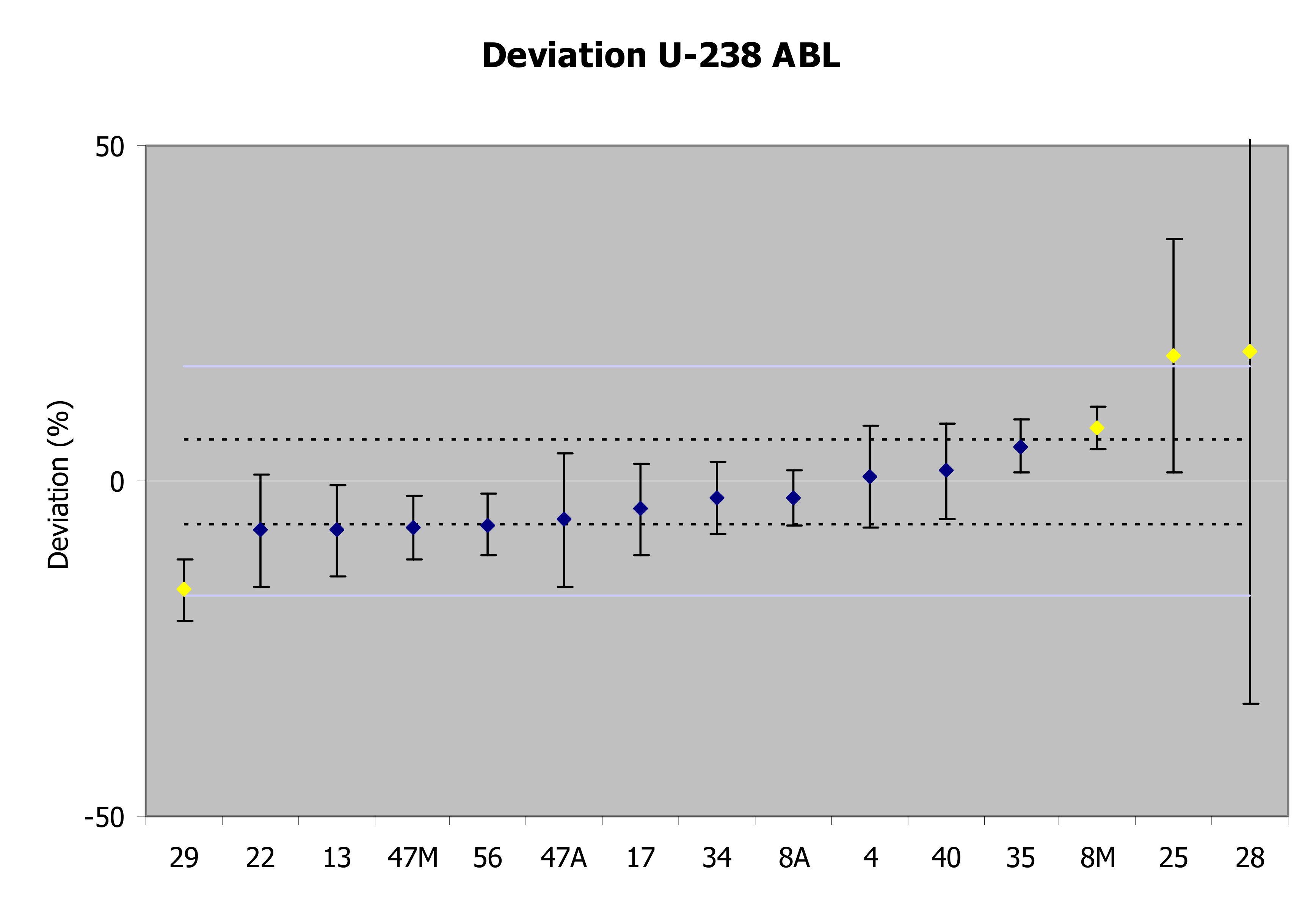


Figure 4B – Zeta score U-238 ABL

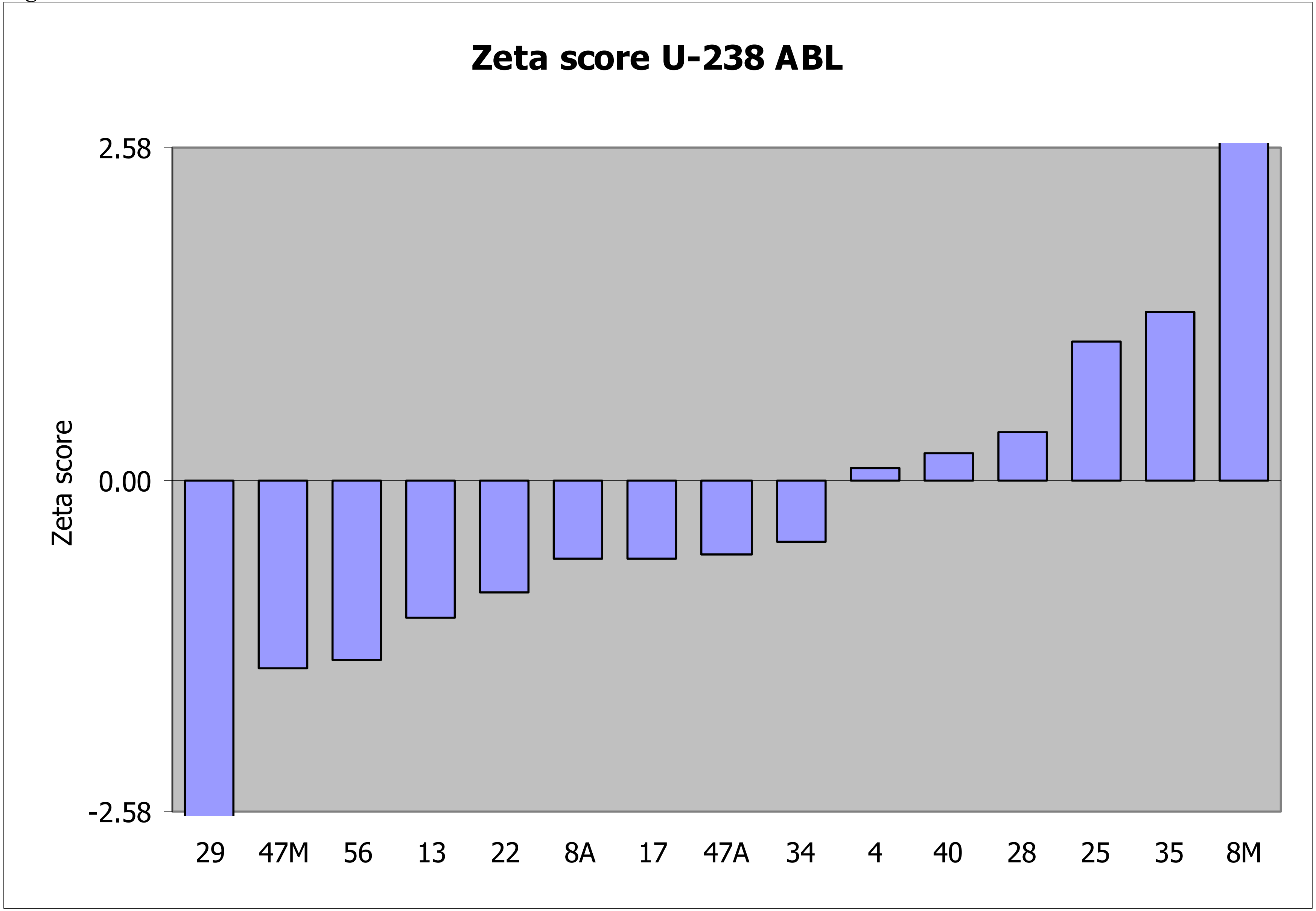


Figure 4C – Relative uncertainty U-238 ABL

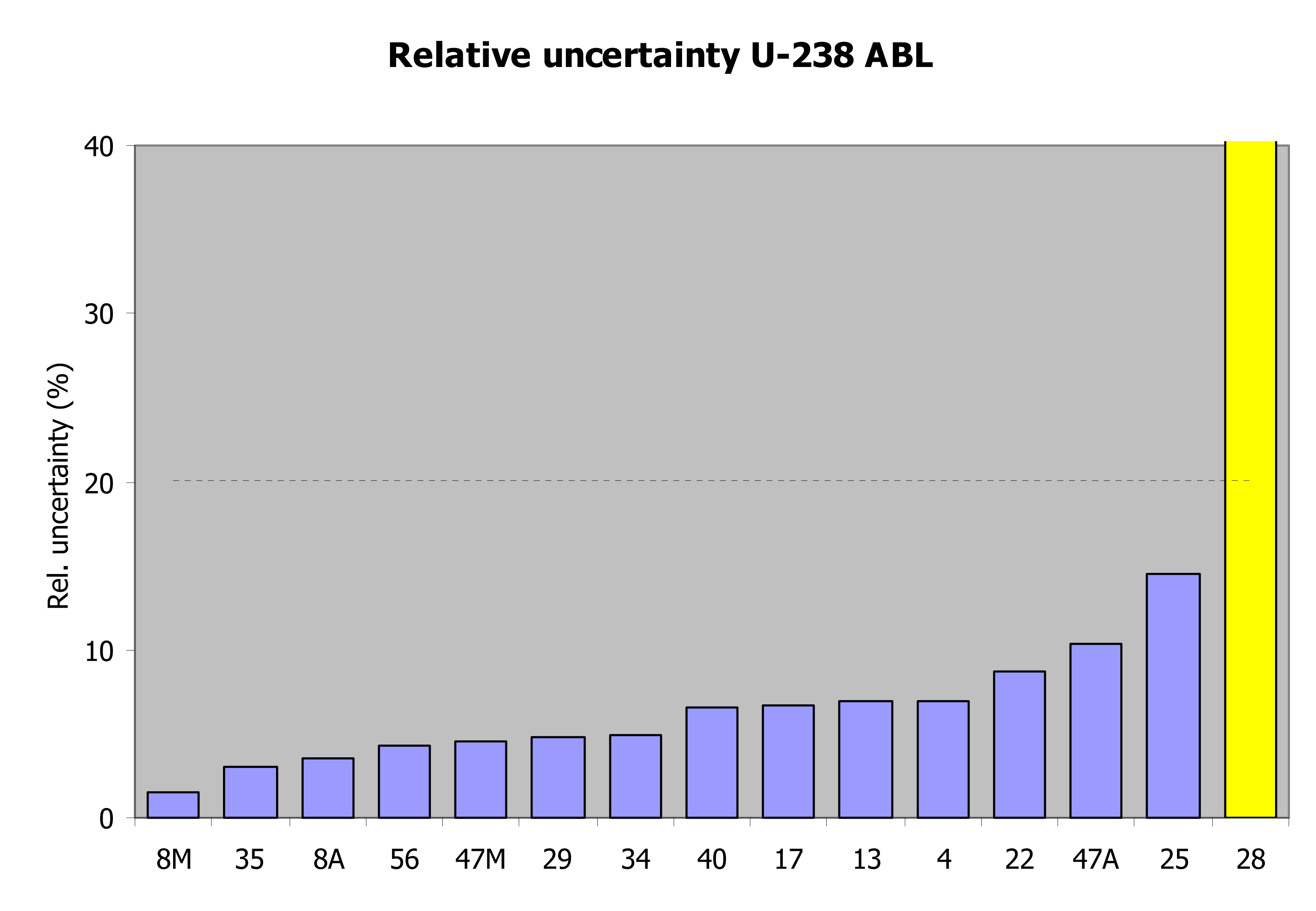


Figure 4D – Kiri plot U-238 ABL

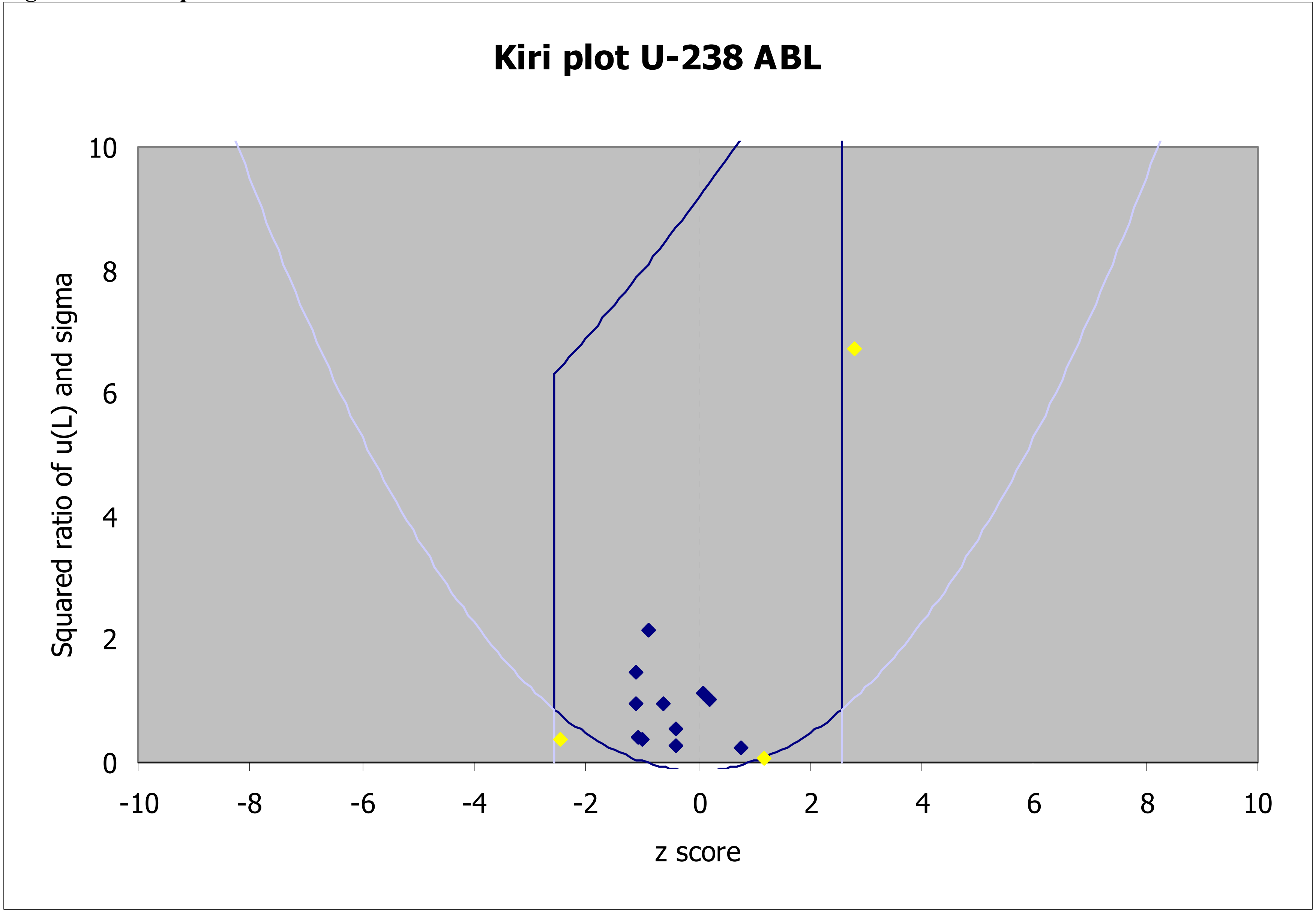


Figure 5A – Deviation Pu-238 ABL

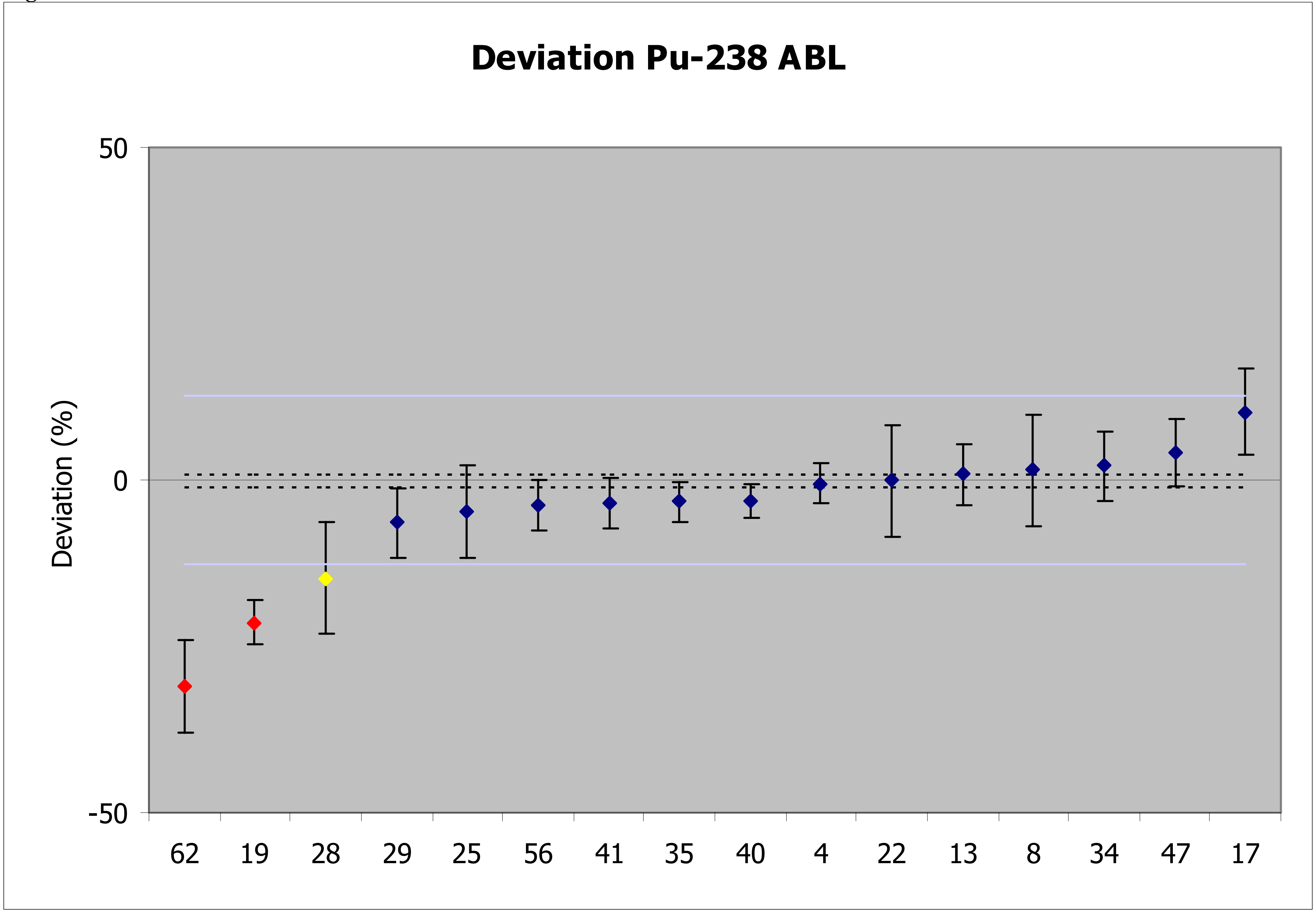


Figure 5B – Zeta score Pu-238 ABL

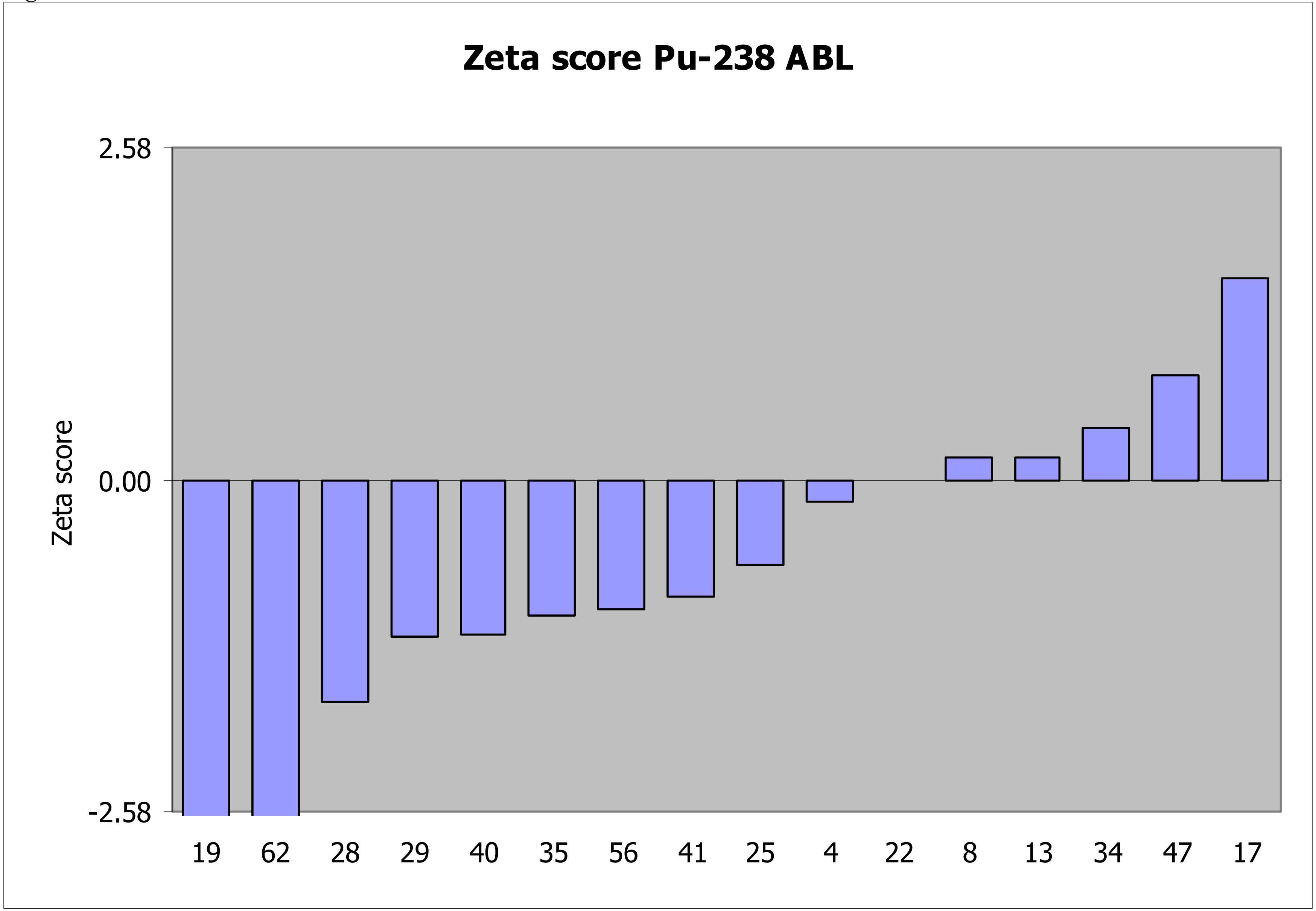


Figure 5C – Relative uncertainty Pu-238 ABL

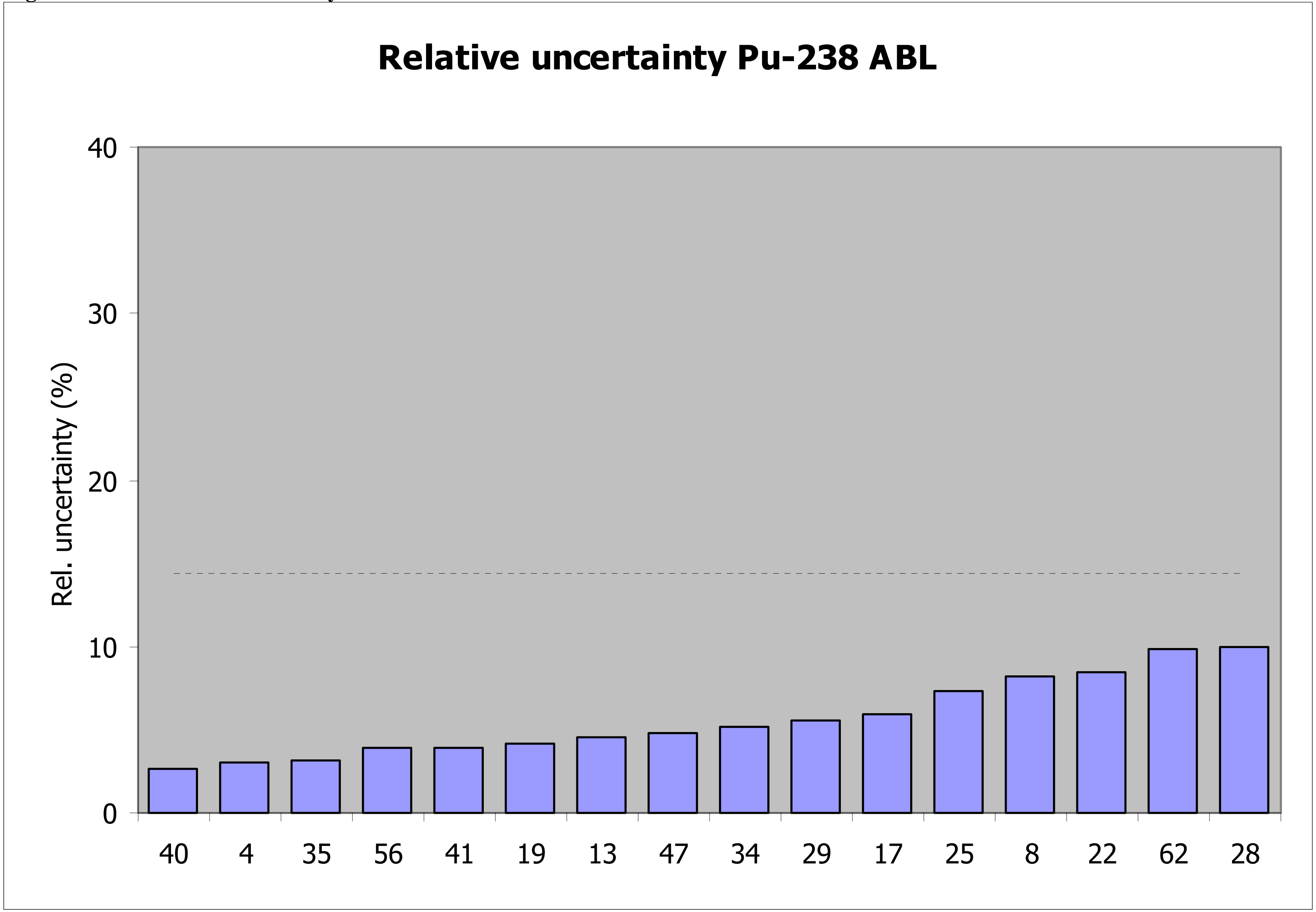


Figure 5D – Kiri plot Pu-238 ABL

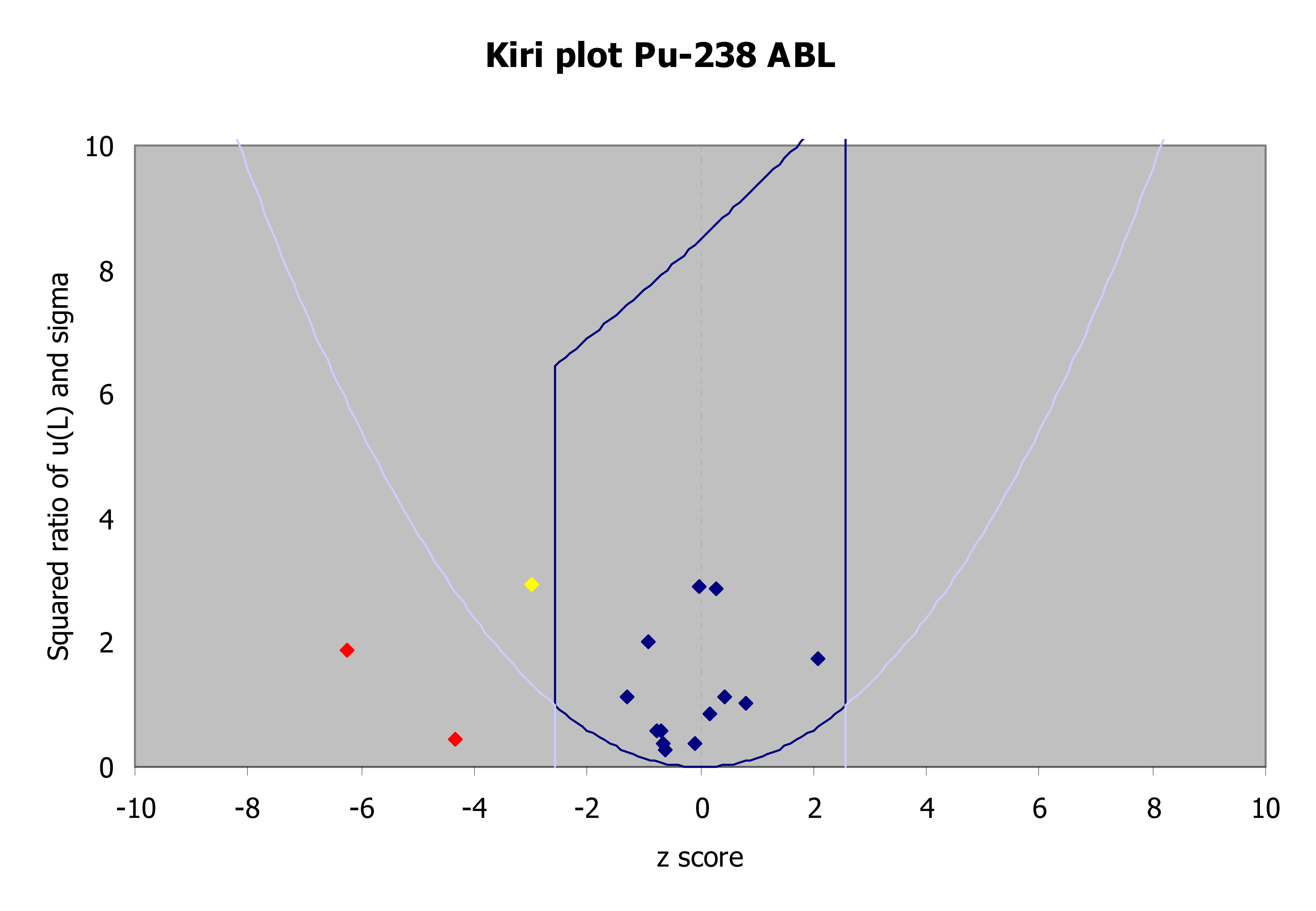


Figure 6A – Deviation Pu-239 ABL

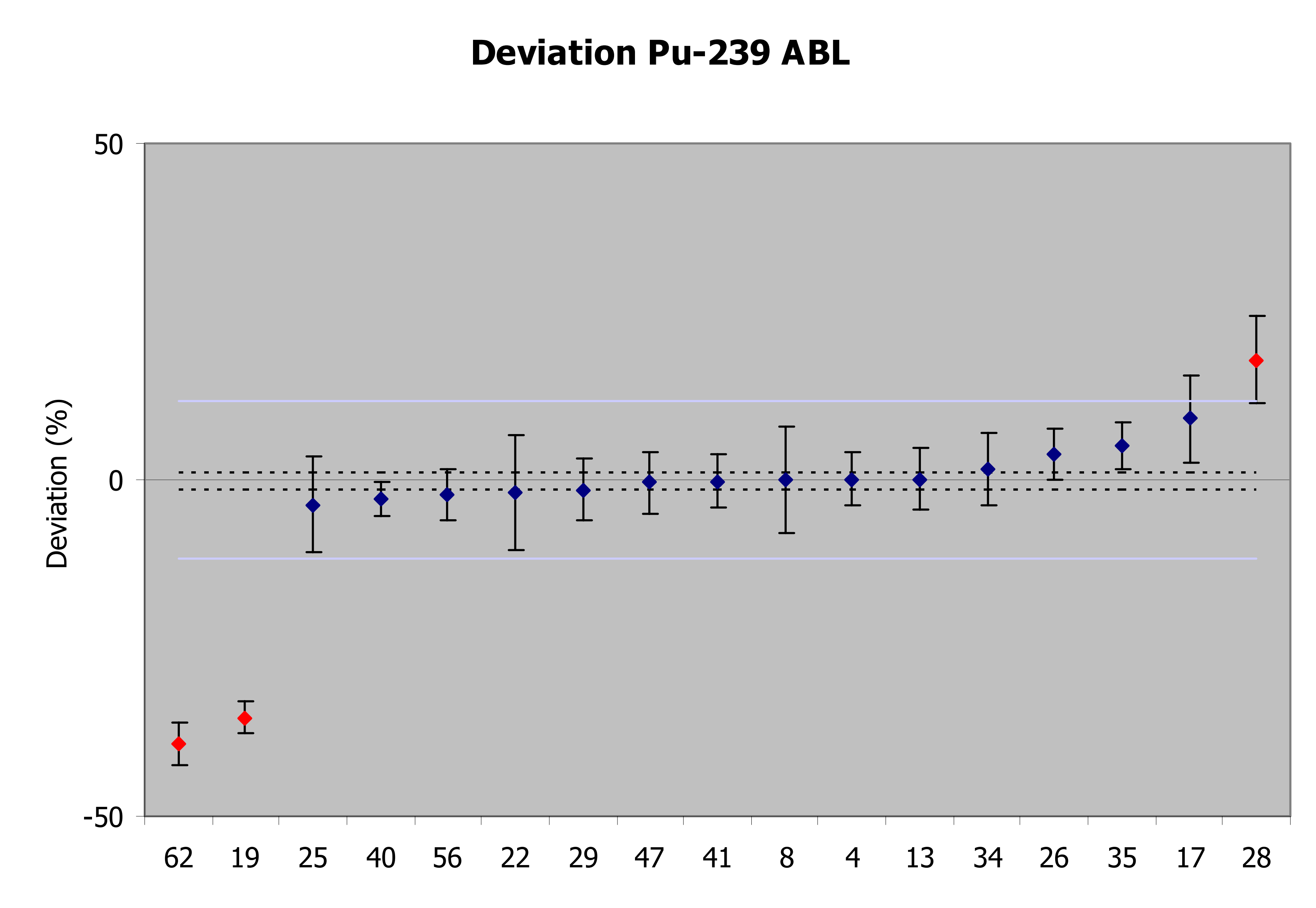


Figure 6B – Zeta score Pu-239 ABL

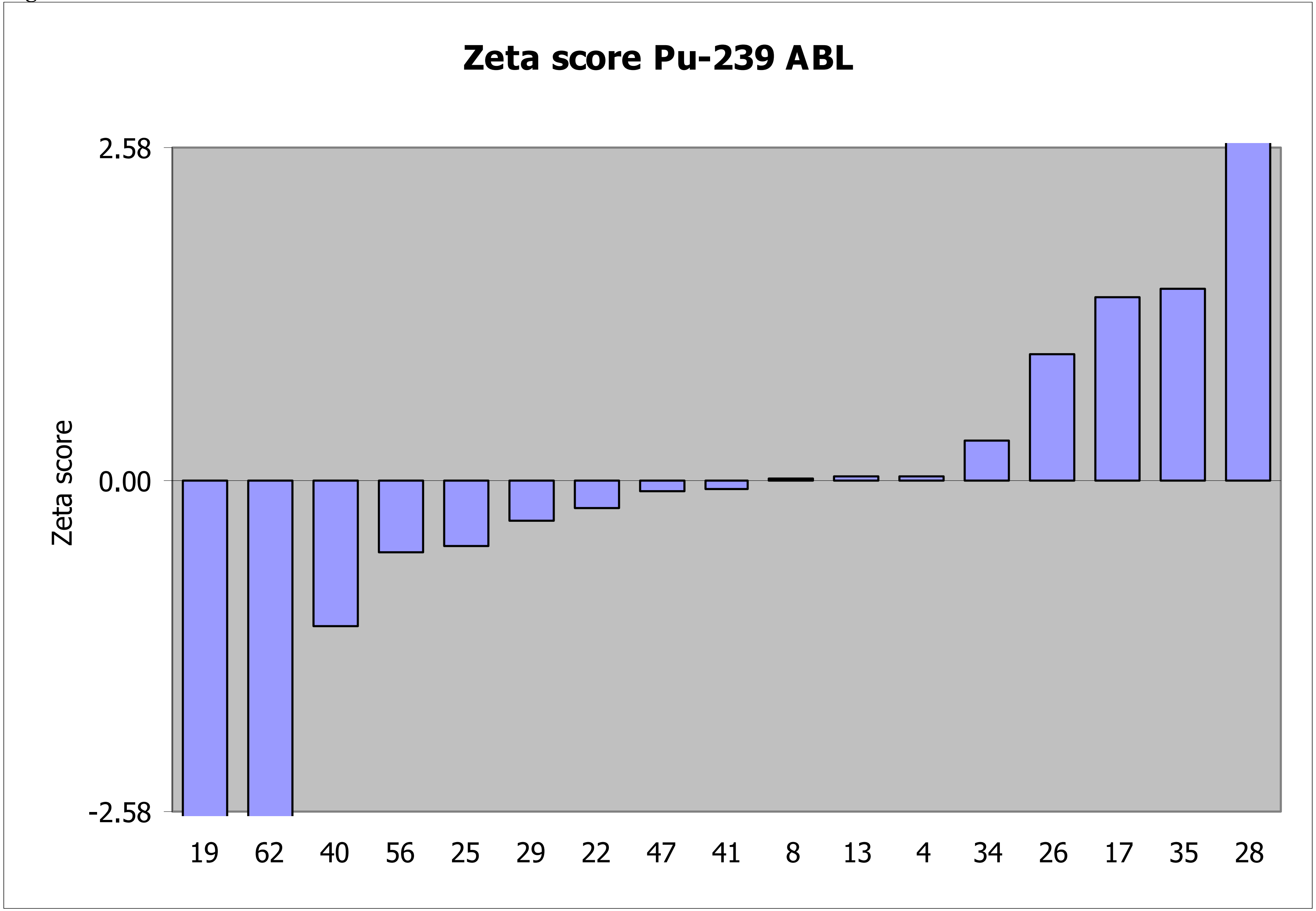


Figure 6C – Relative uncertainty Pu-239 ABL

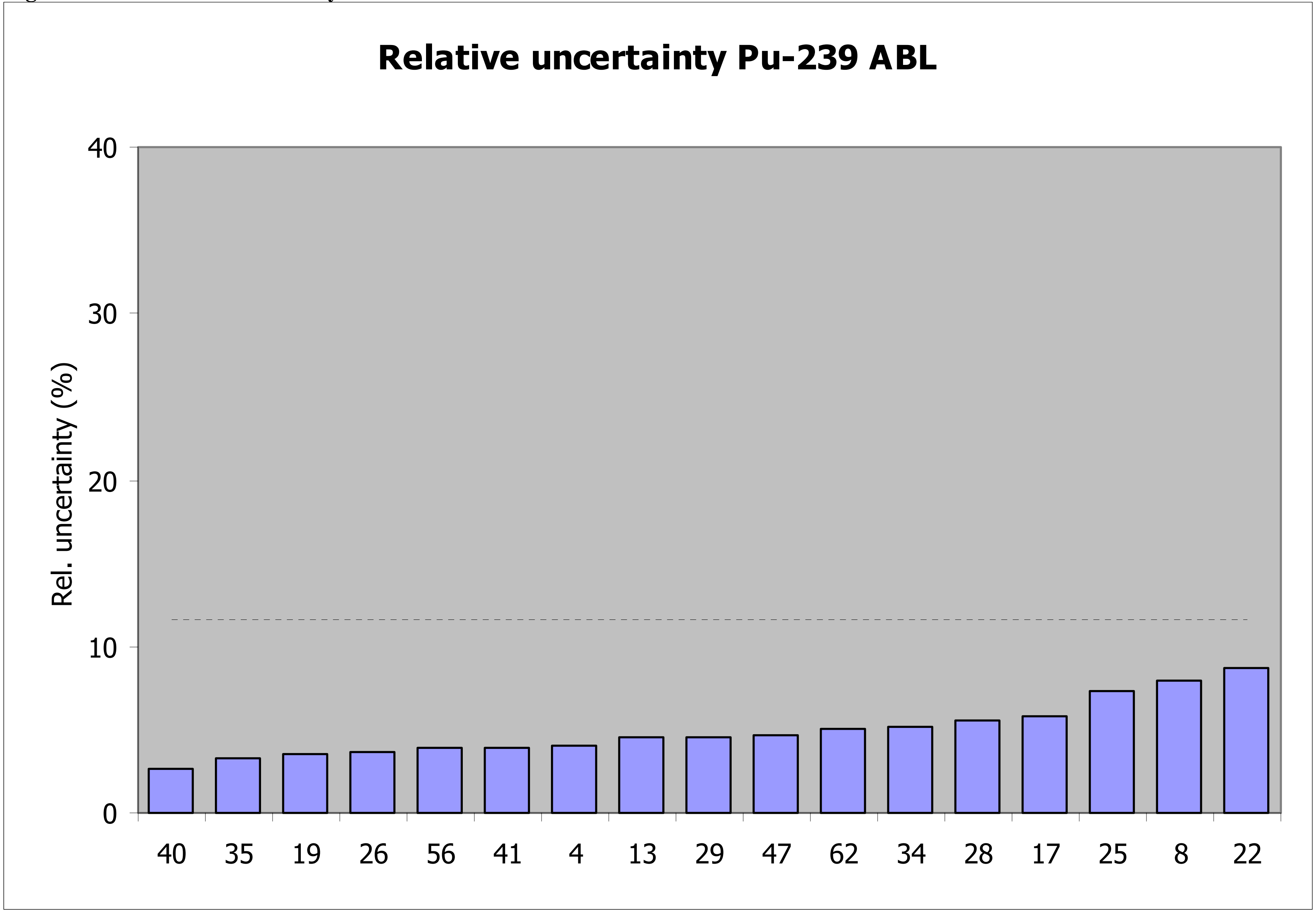


Figure 6D – Kiri plot Pu-239 ABL

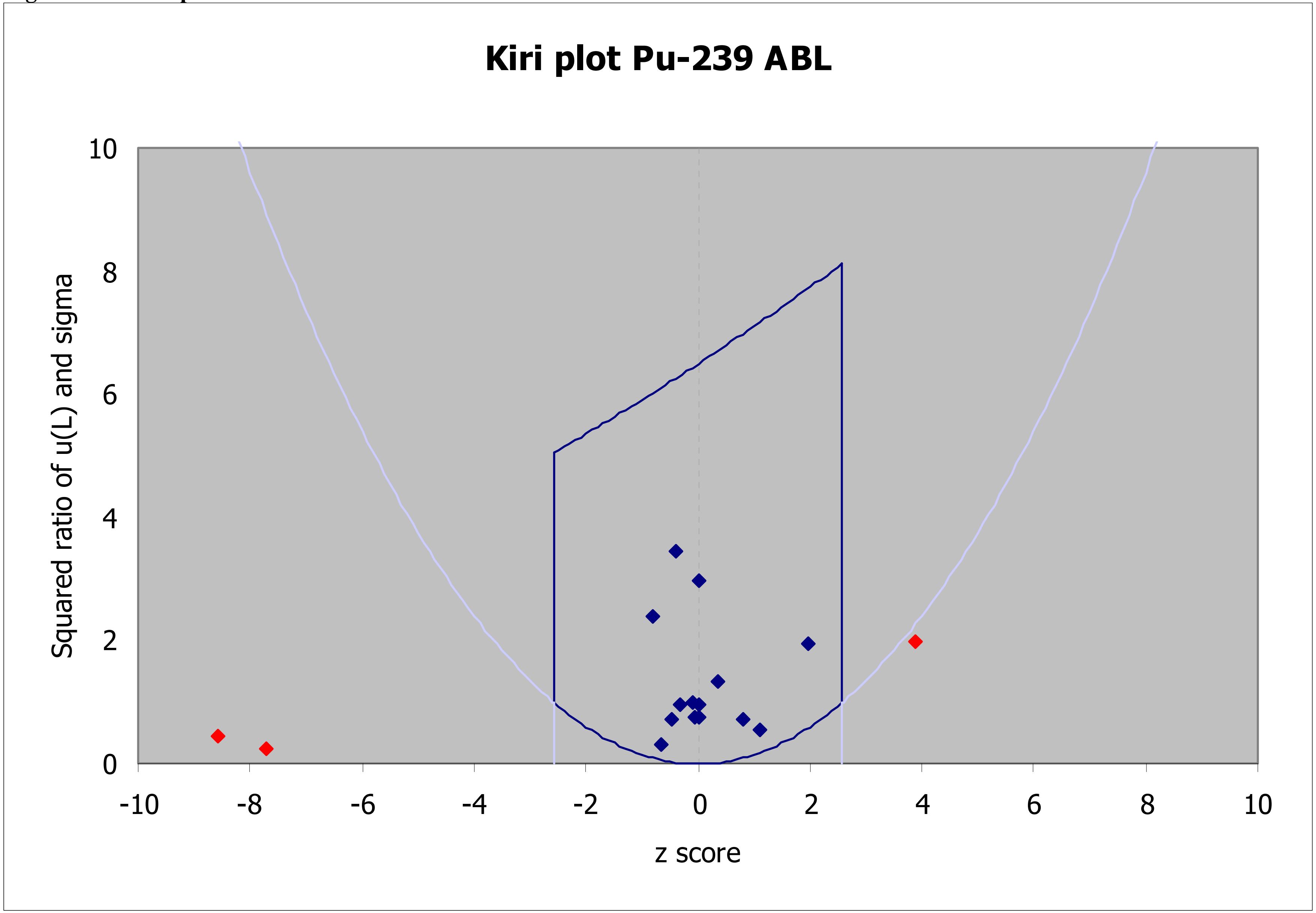


Figure 7A – Deviation Am-241 ABL

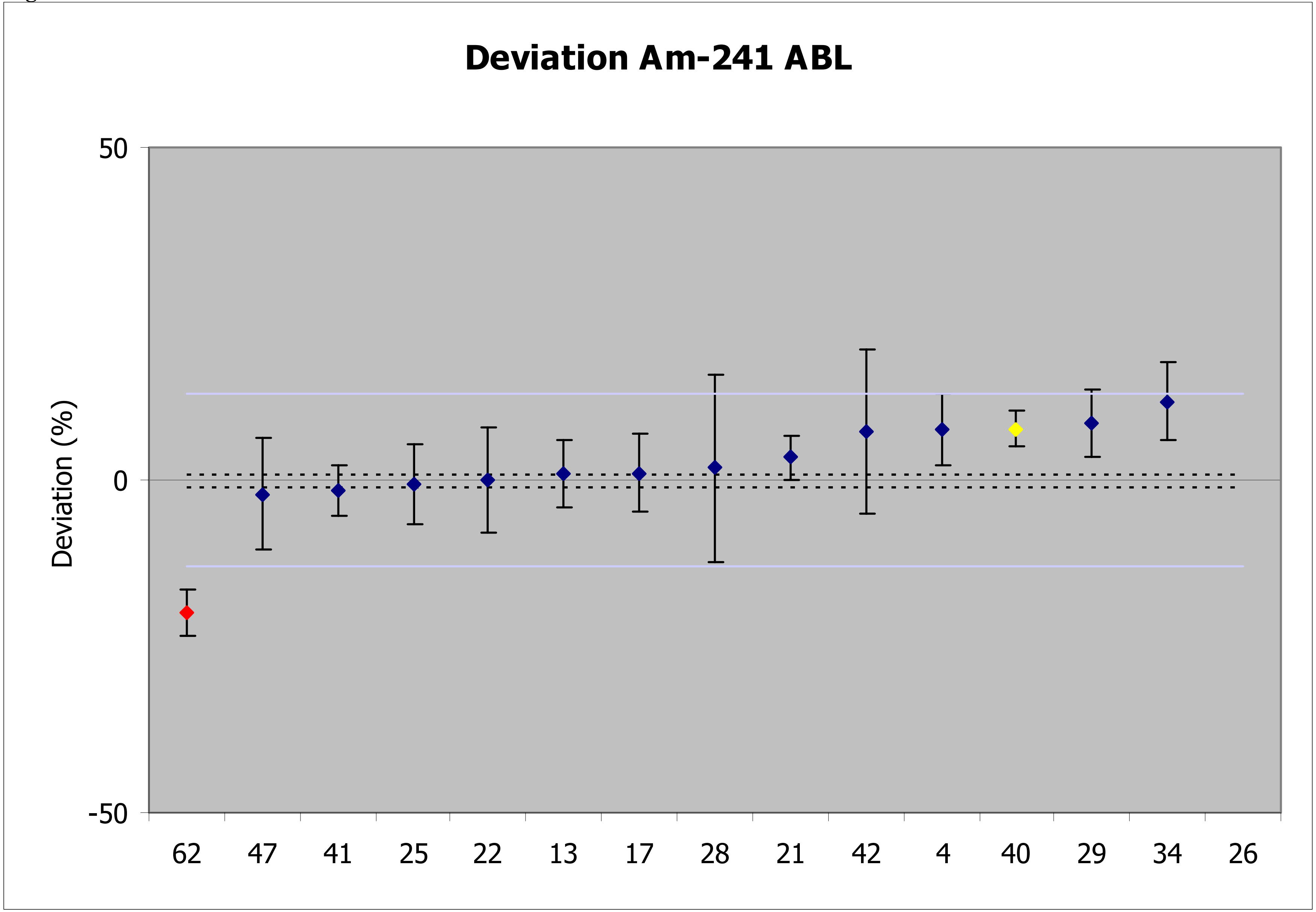


Figure 7B – Zeta score Am-241 ABL

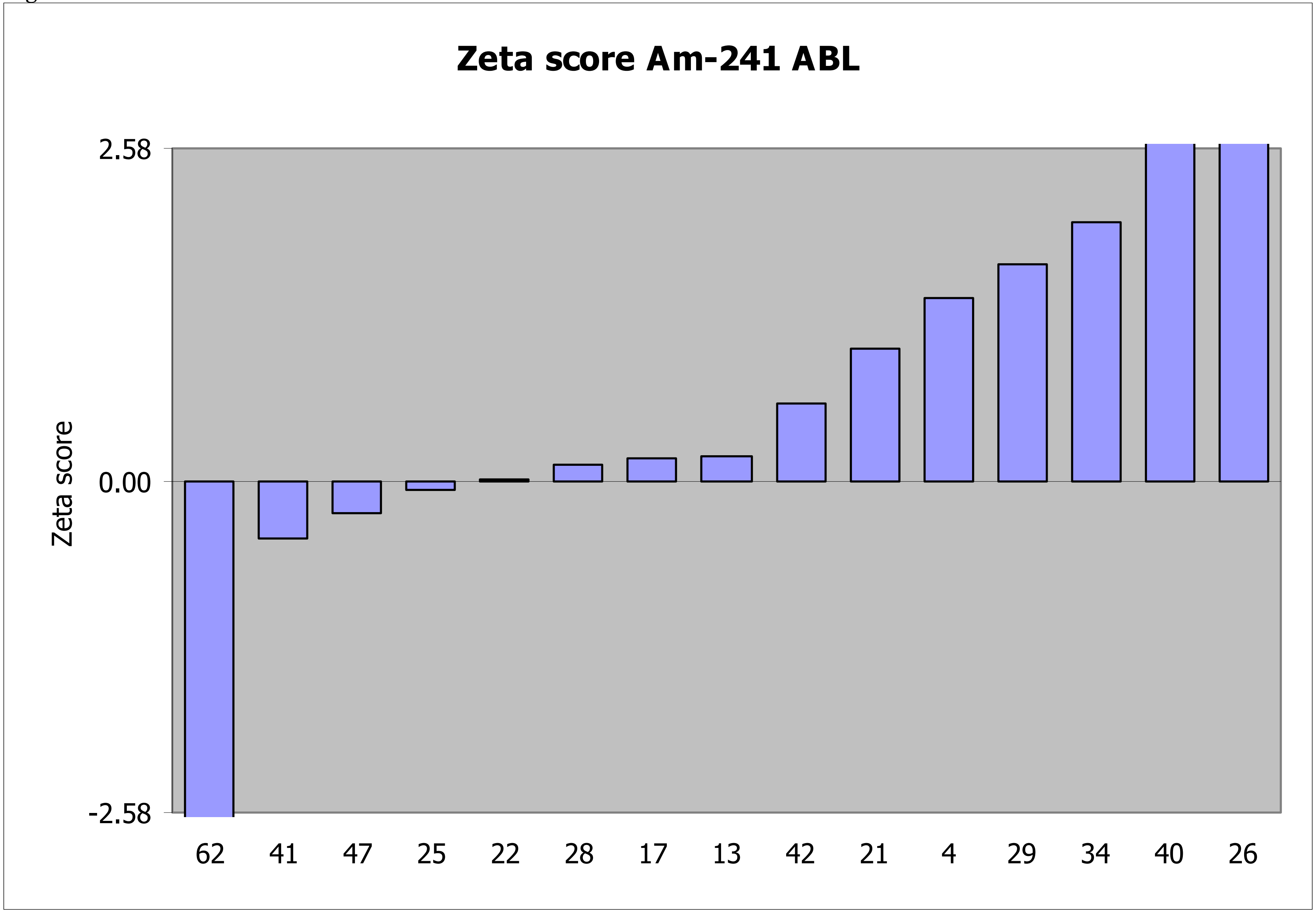


Figure 7C – Relative uncertainty Am-241 ABL

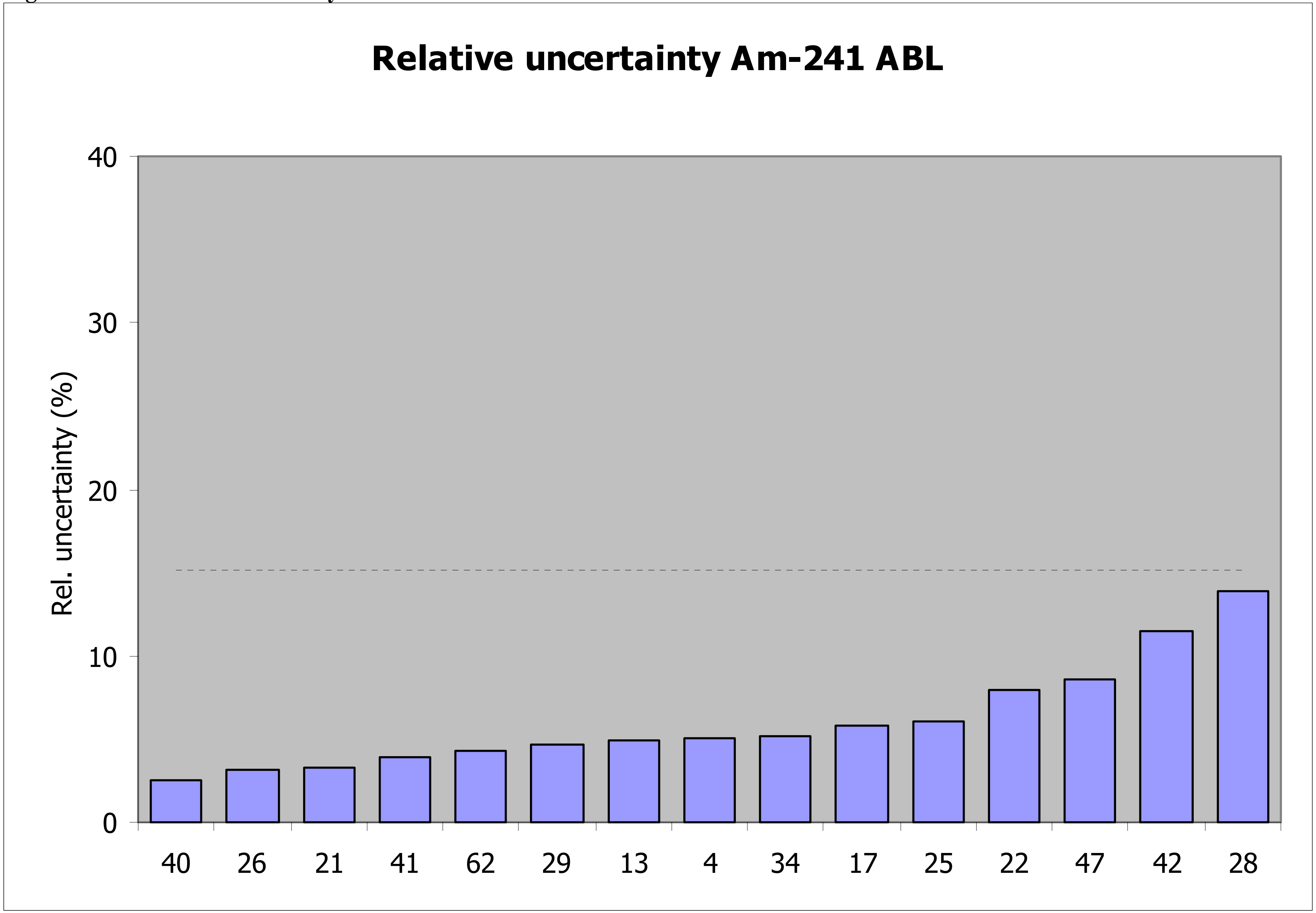


Figure 7D – Kiri plot Am-241 ABL

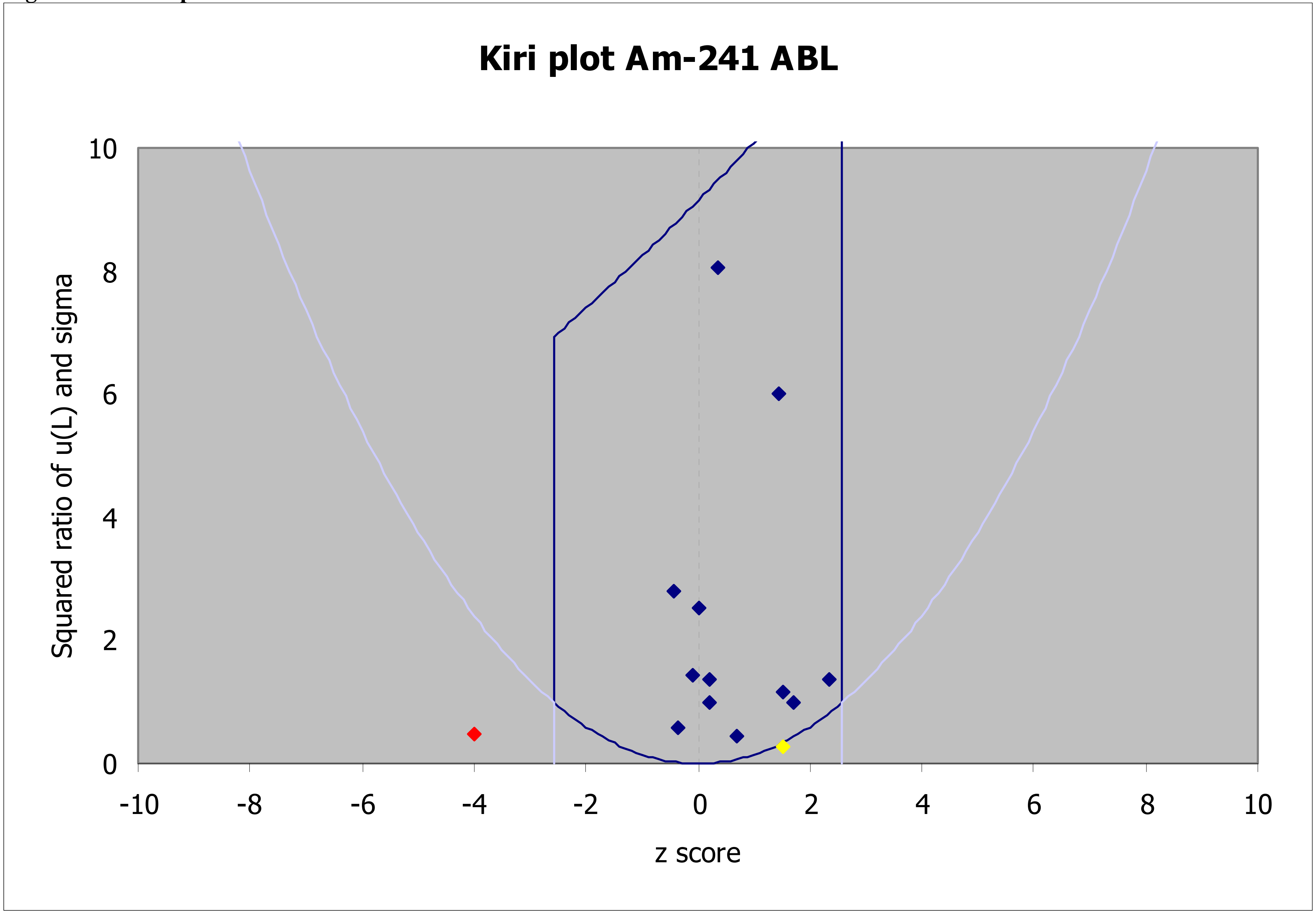


Figure 8A – Deviation Fe-55 ABH

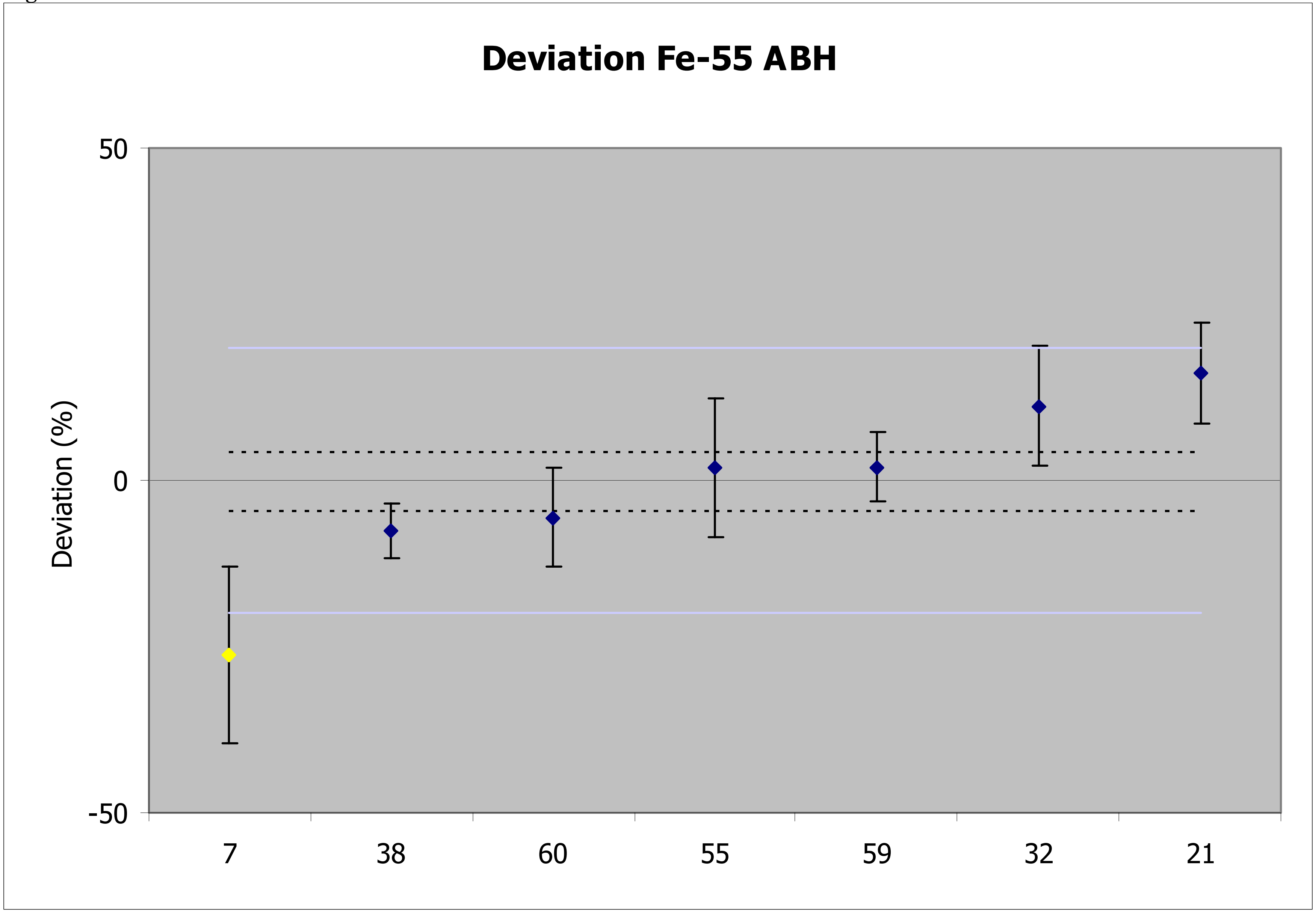


Figure 8B – Zeta score Fe-55 ABH

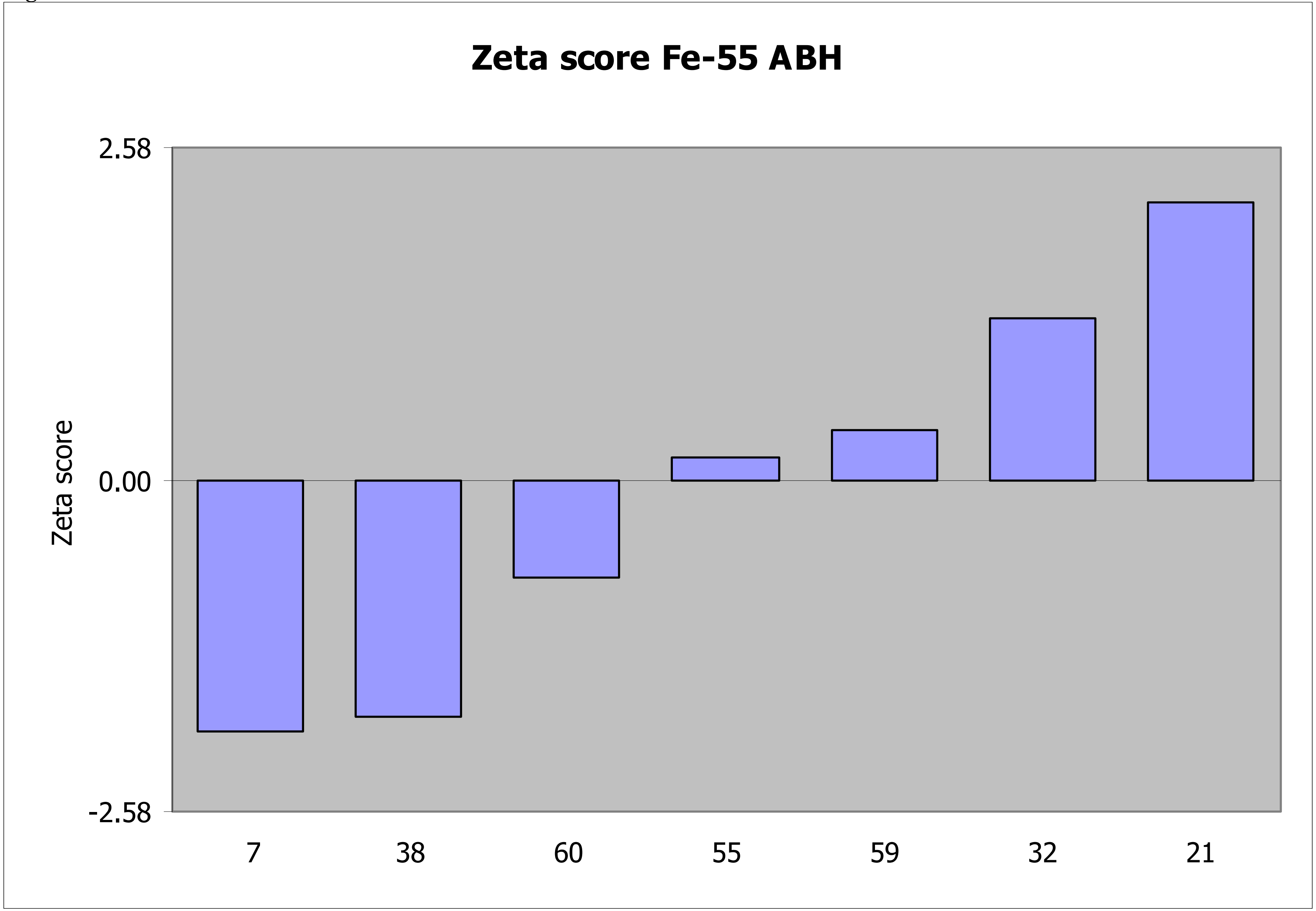


Figure 8C – Relative uncertainty Fe-55 ABH

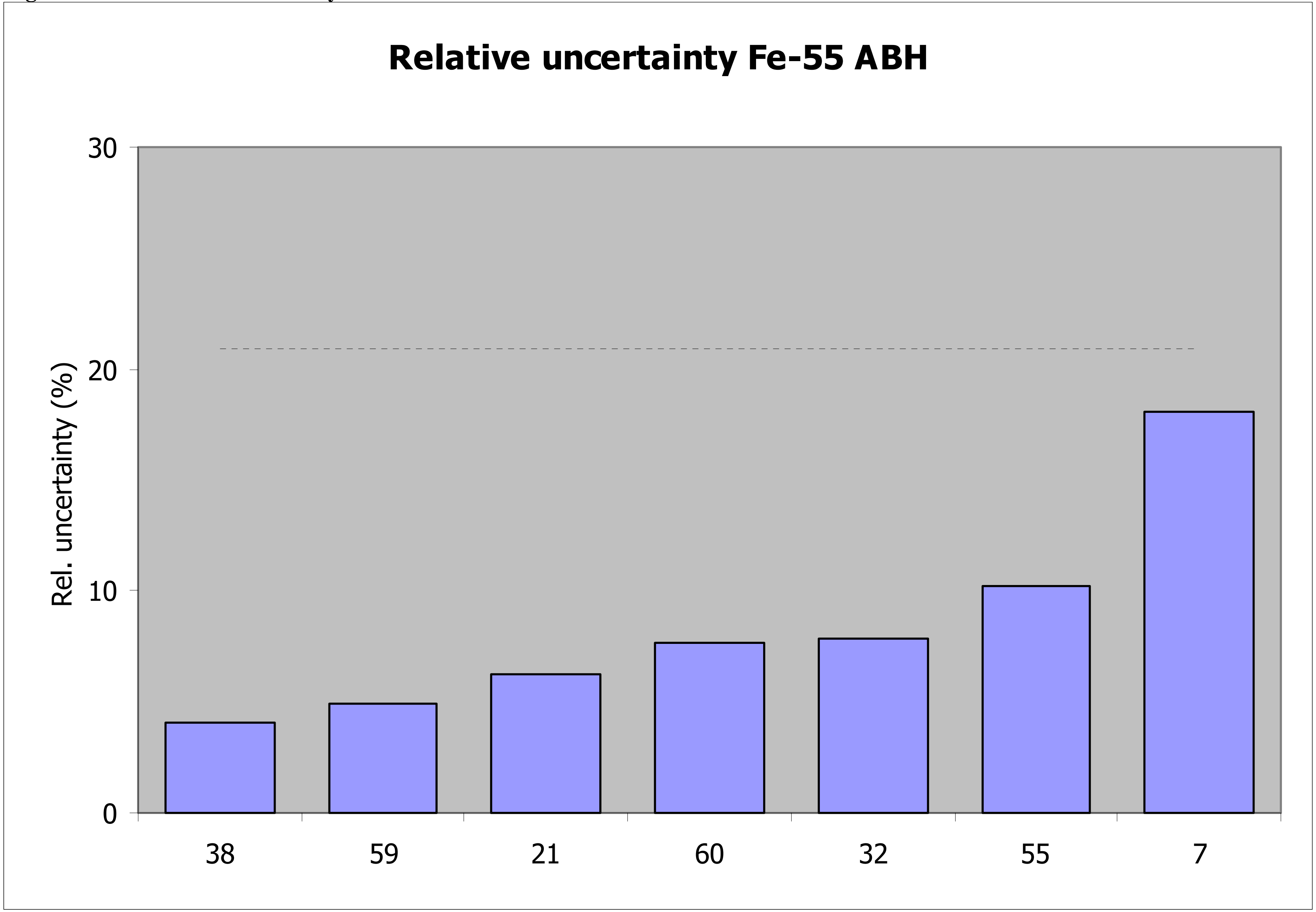


Figure 8D – Kiri plot Fe-55 ABH

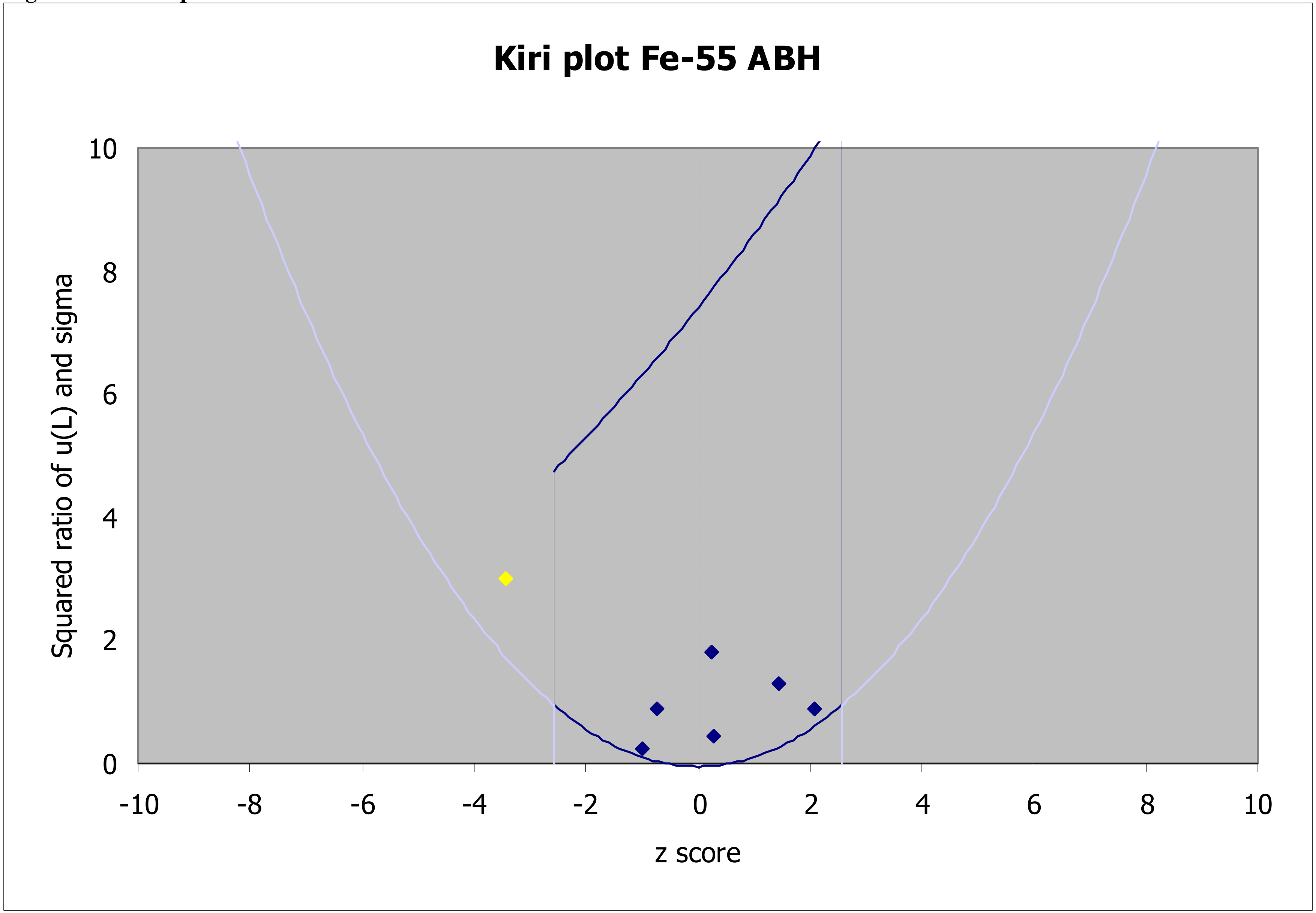


Figure 9A – Deviation Sr-89 ABH

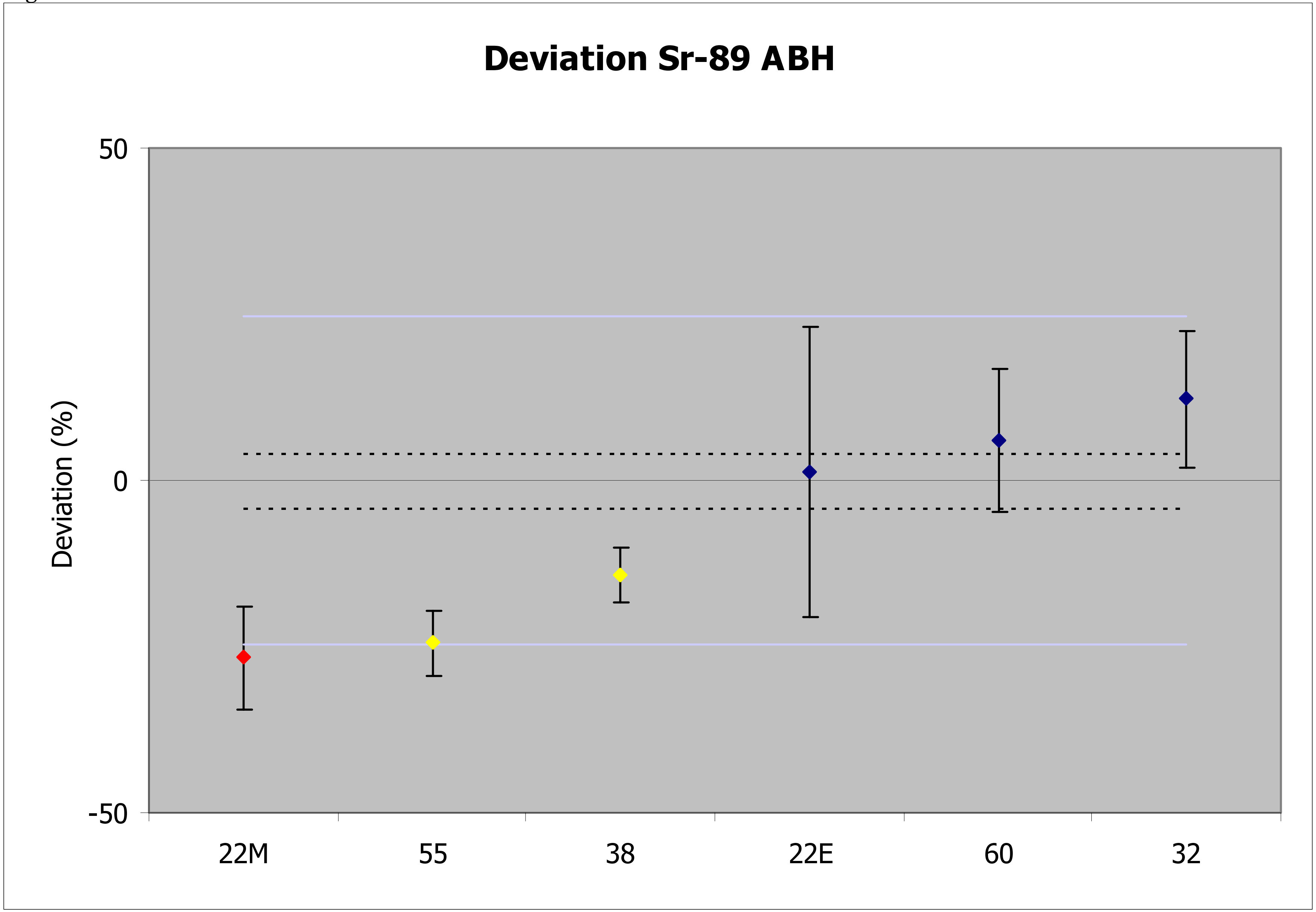


Figure 9B – Zeta score Sr-89 ABH

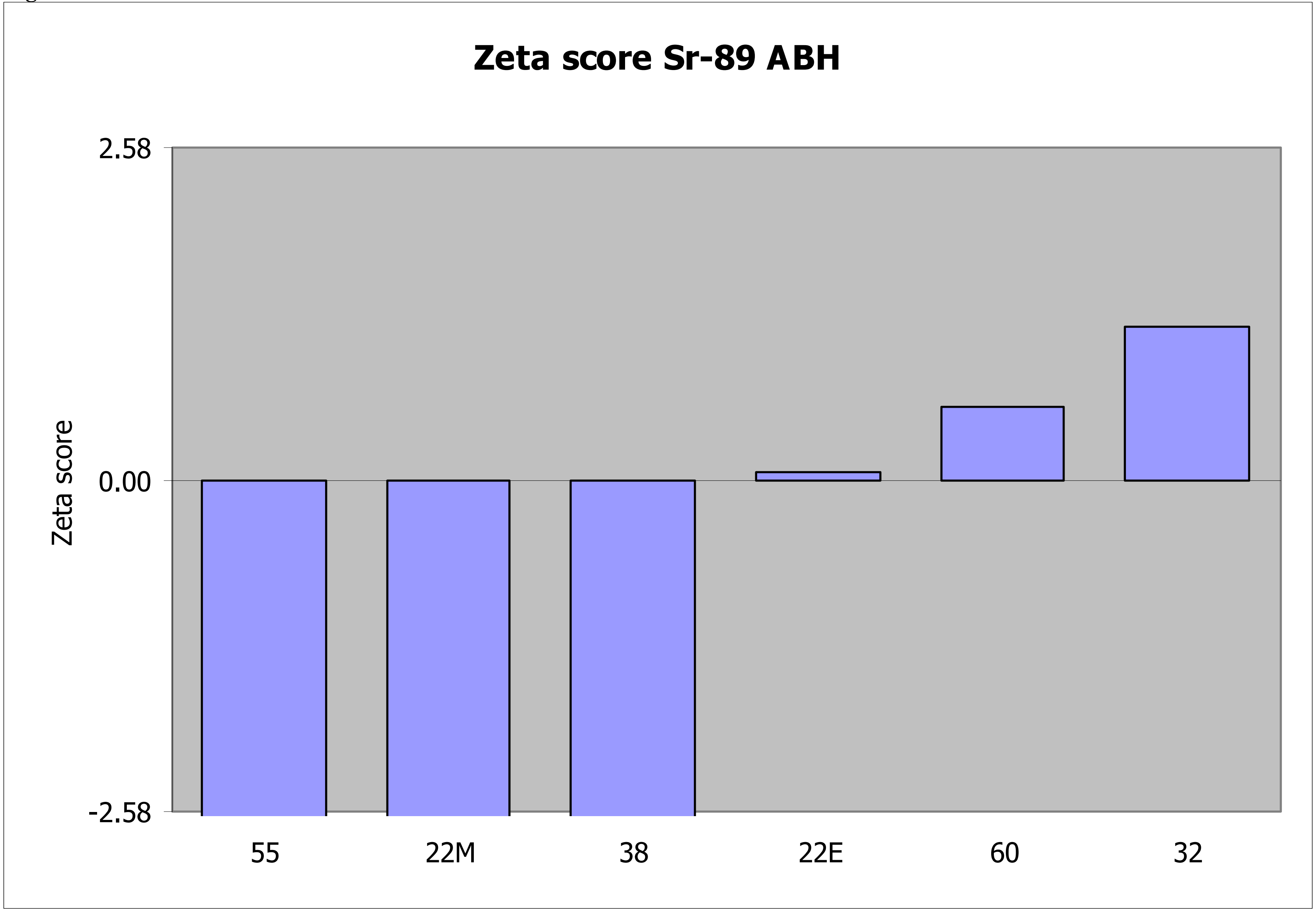


Figure 9C – Relative uncertainty Sr-89 ABH

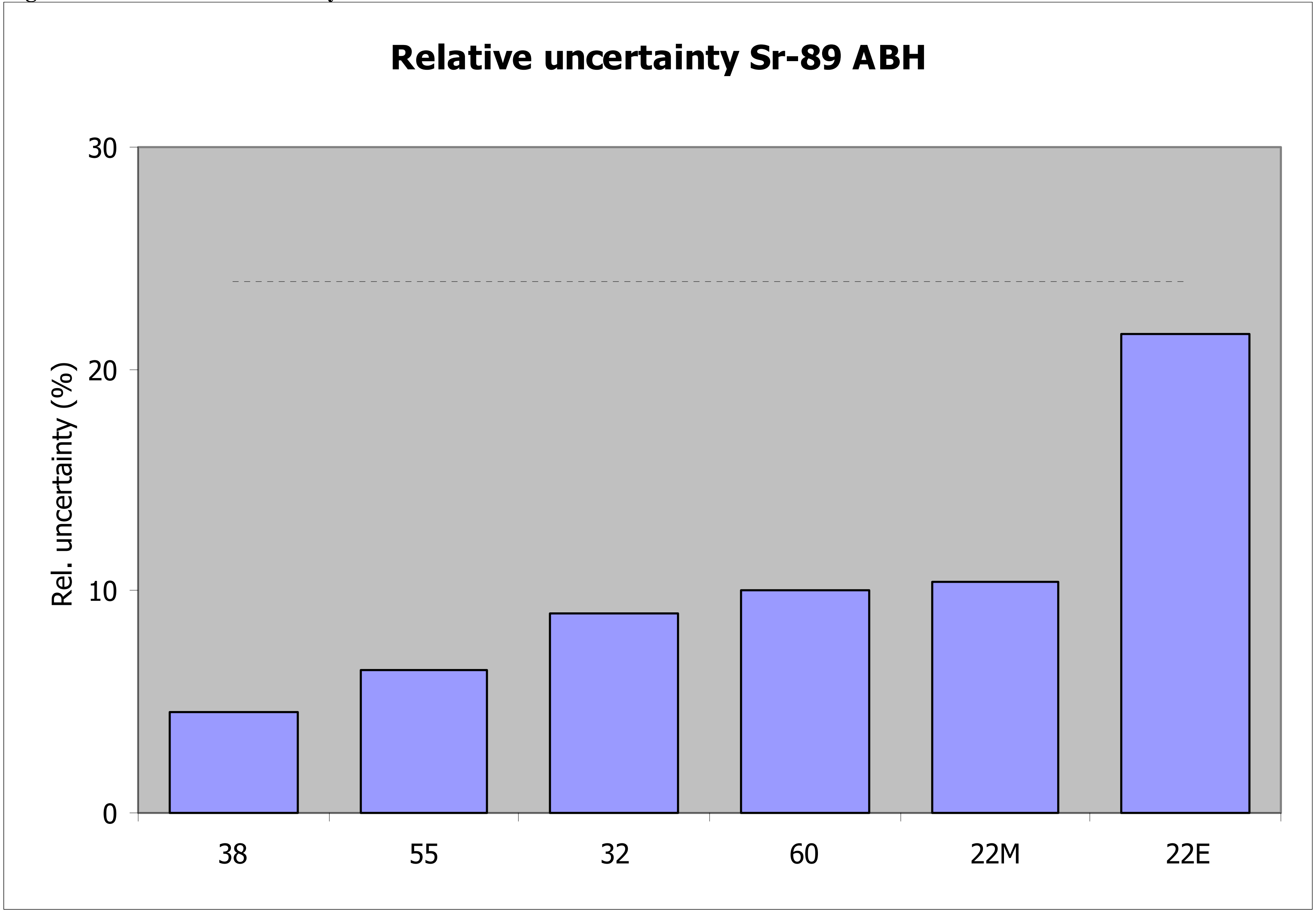


Figure 9D – Kiri plot Sr-89 ABH

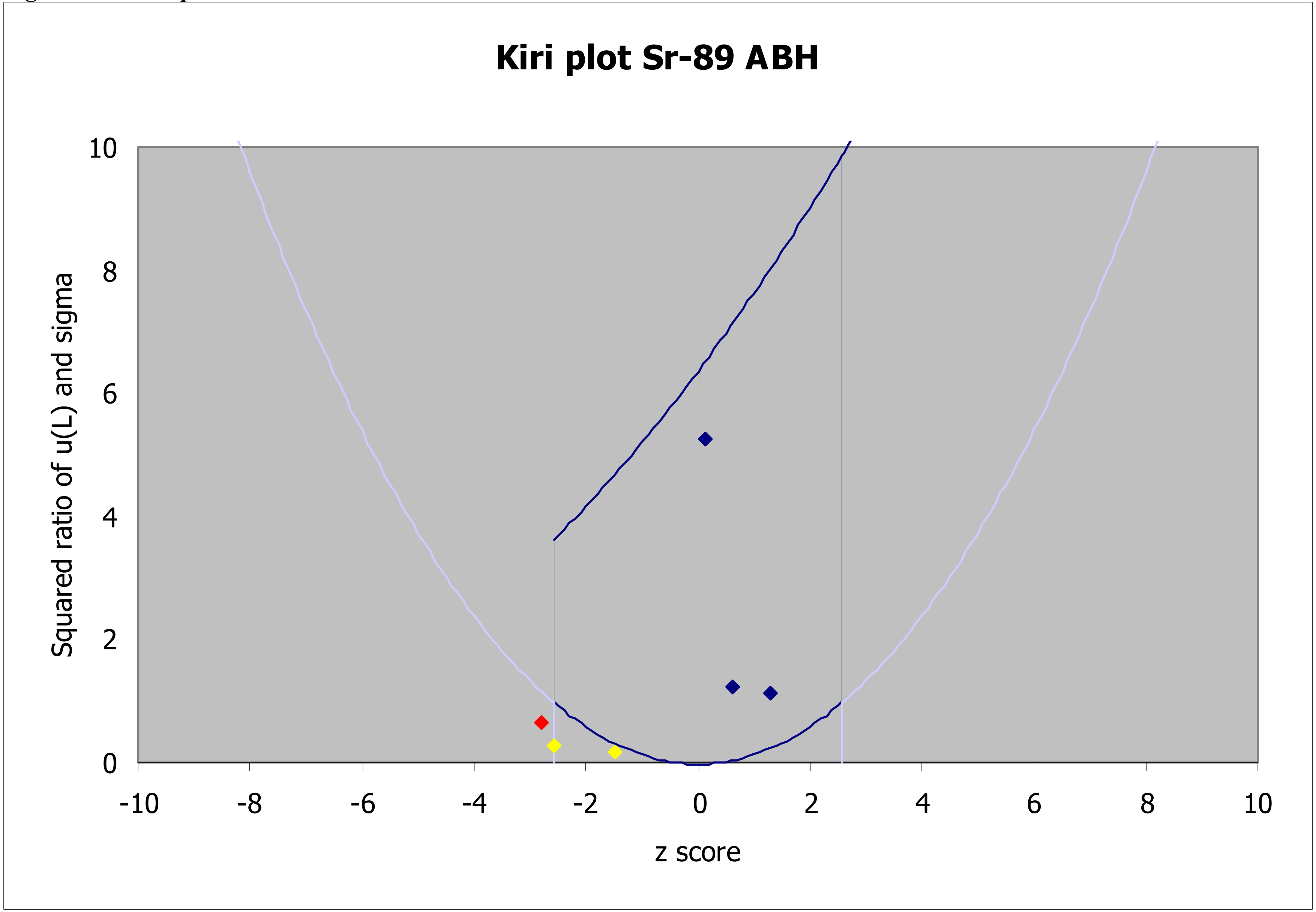


Figure 10A – Deviation Sr-90 ABH

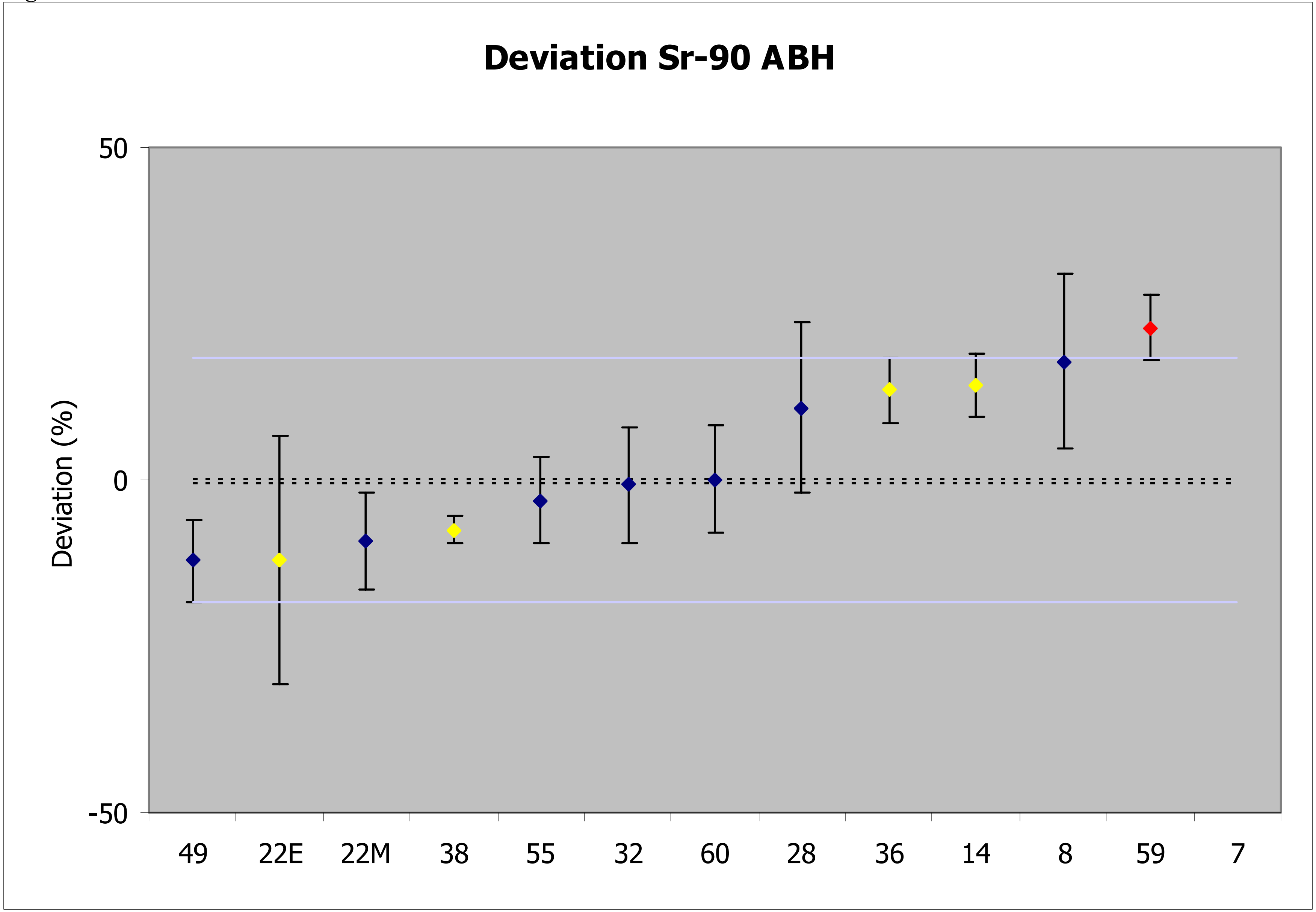


Figure 10B – Zeta score Sr-90 ABH

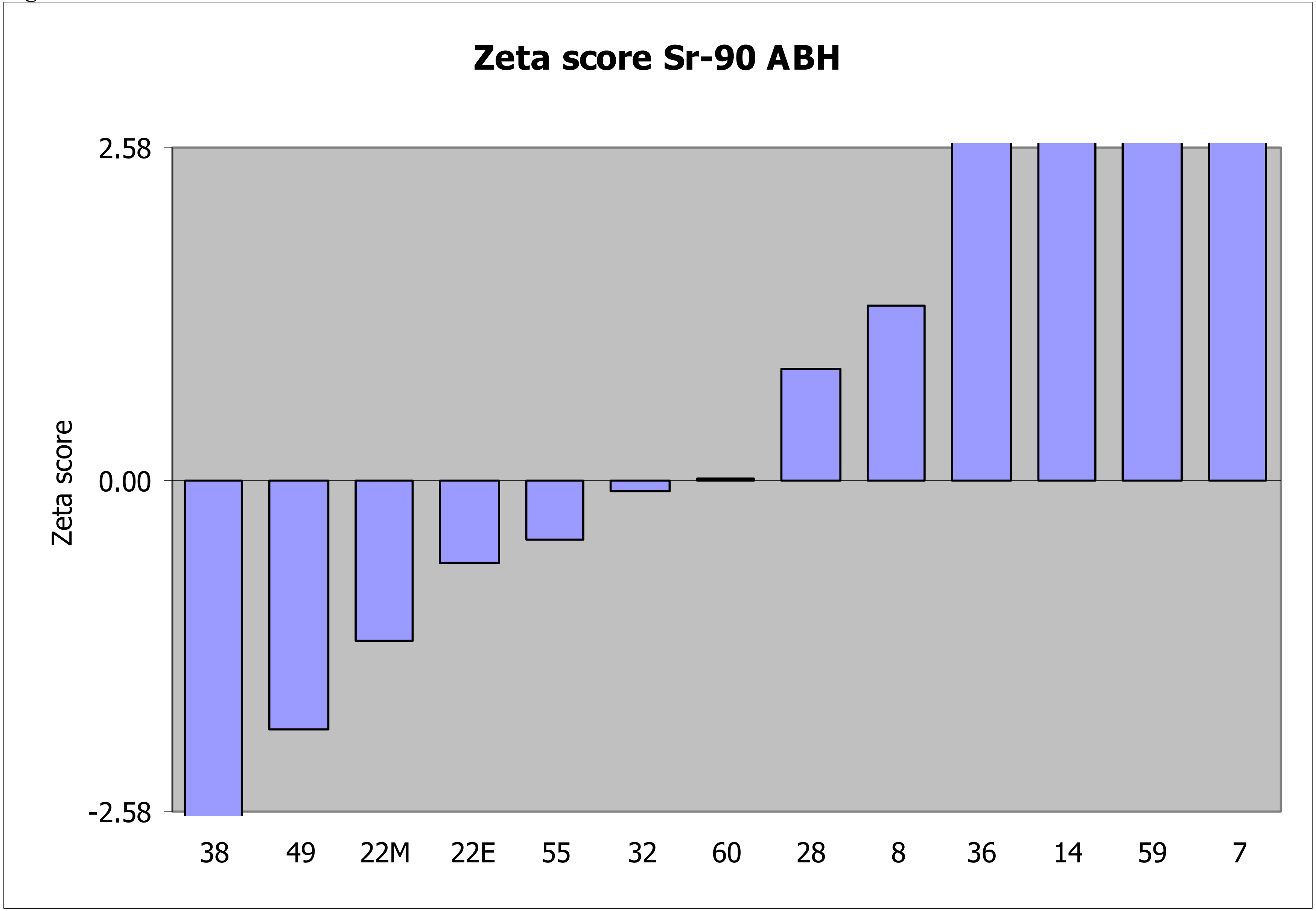


Figure 10C – Relative uncertainty Sr-90 ABH

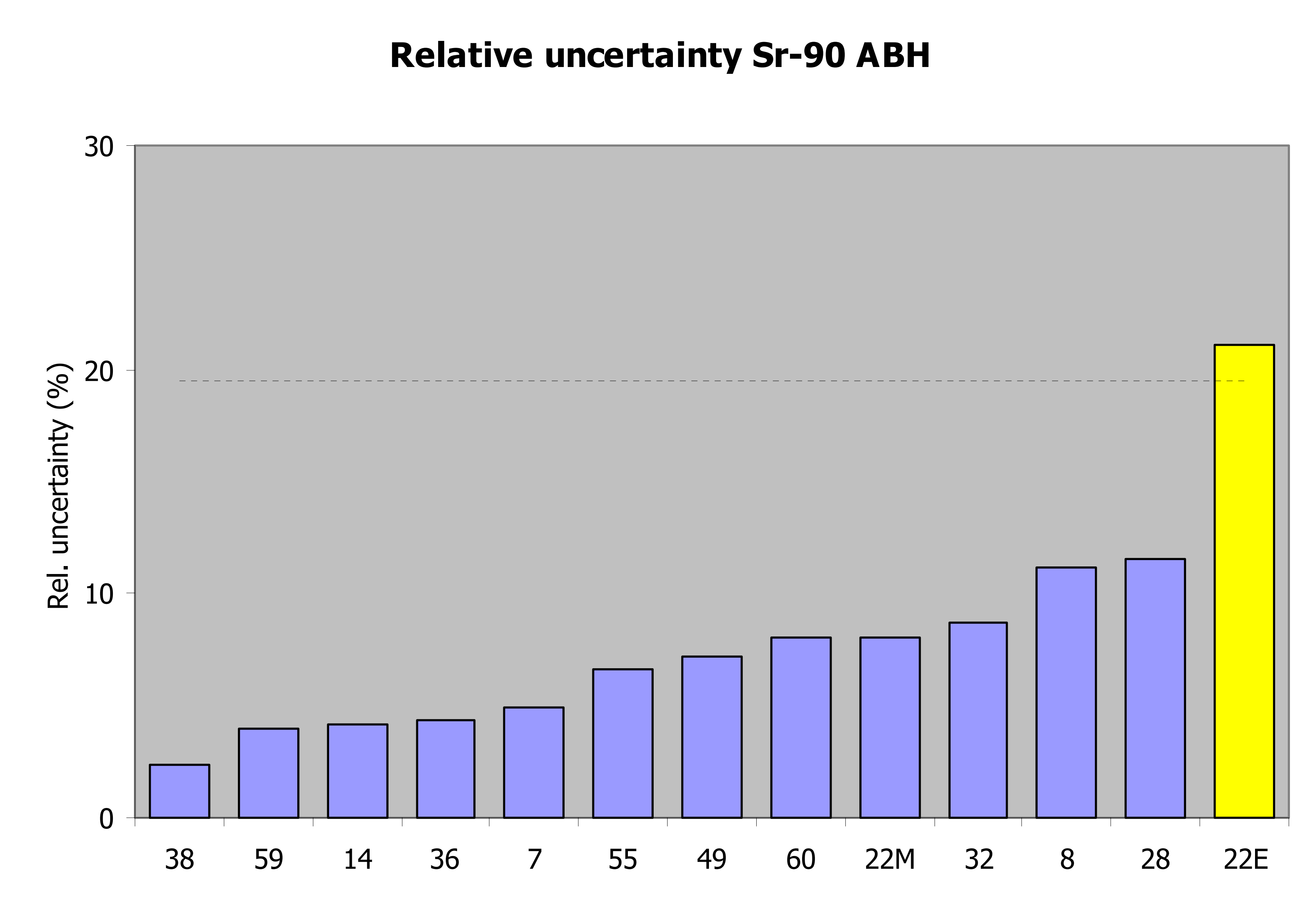


Figure 10D – Kiri plot Sr-90 ABH

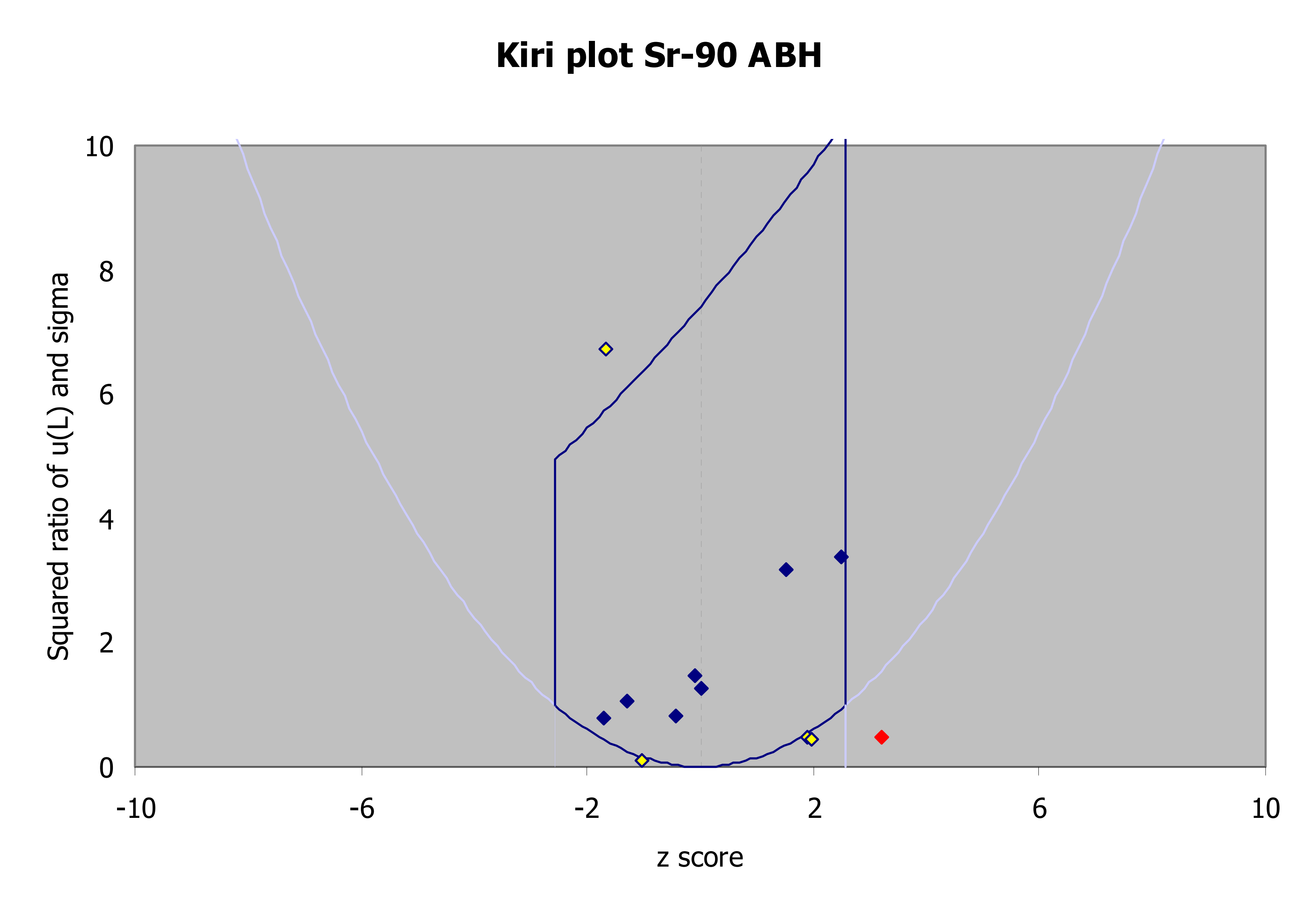


Figure 11A – Deviation U-238 ABH

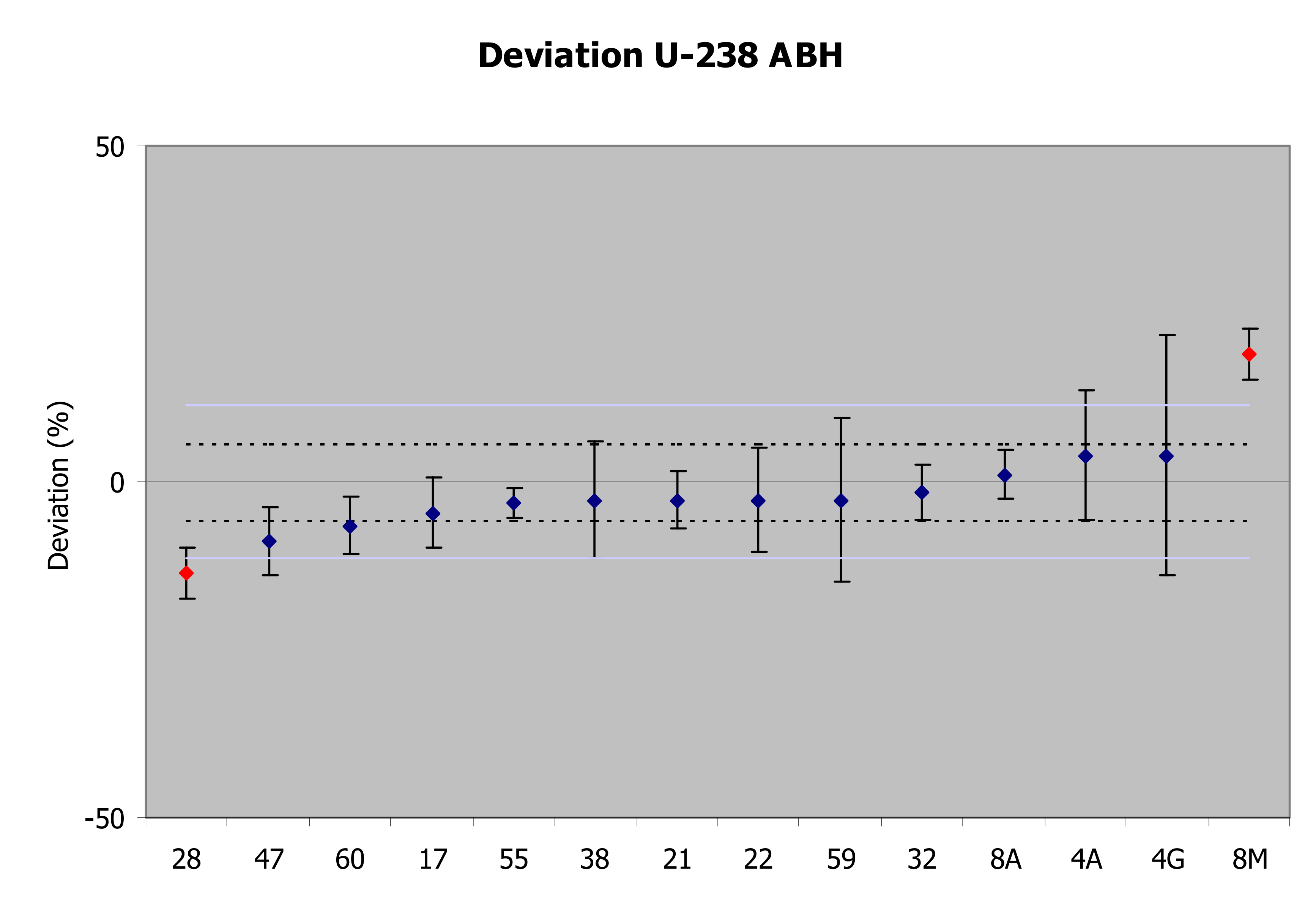


Figure 11B – Zeta score U-238 ABH

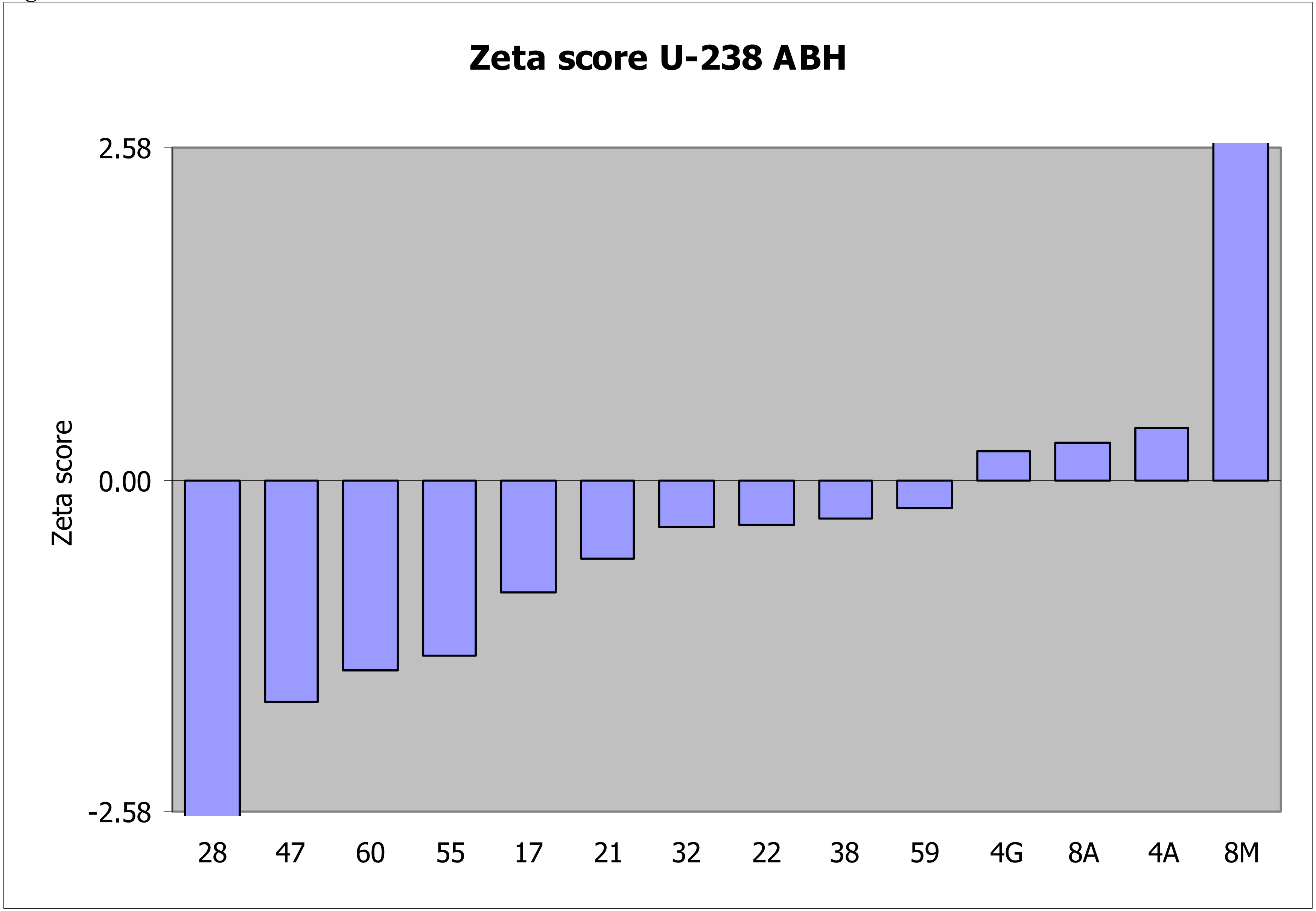


Figure 11C – Relative uncertainty U-238 ABH

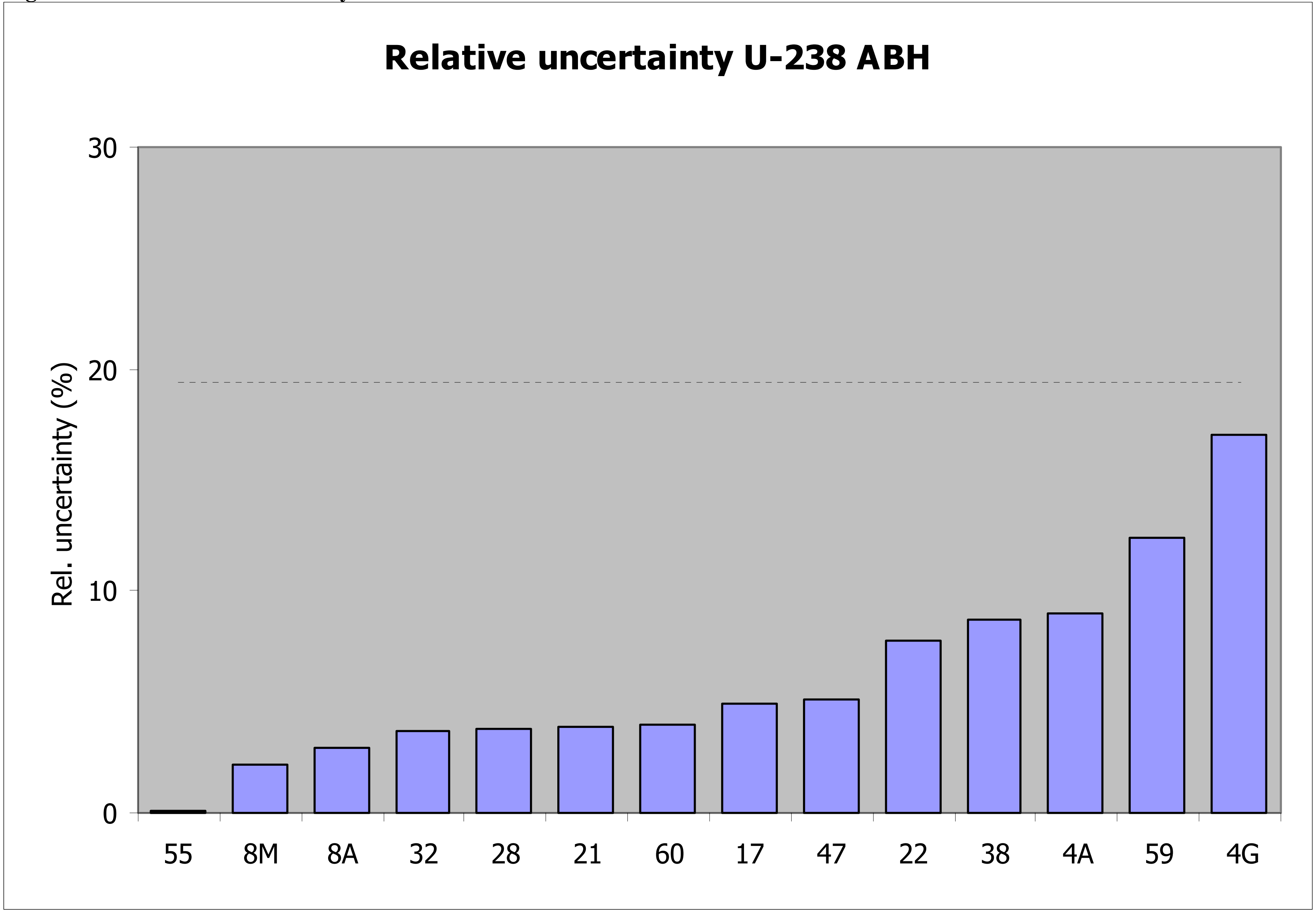


Figure 11D – Kiri plot U-238 ABH

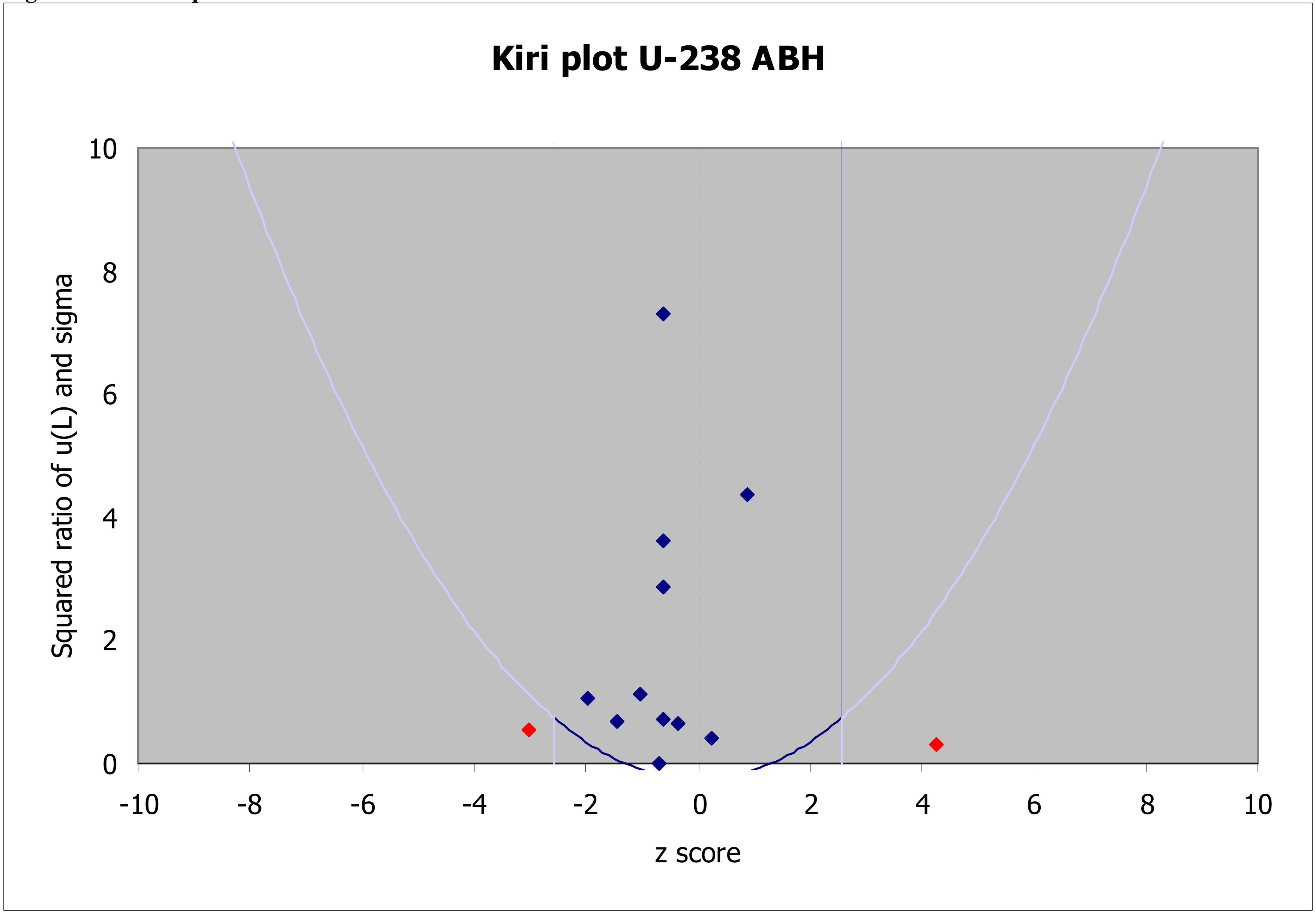


Figure 12A – Deviation Pu-238 ABH

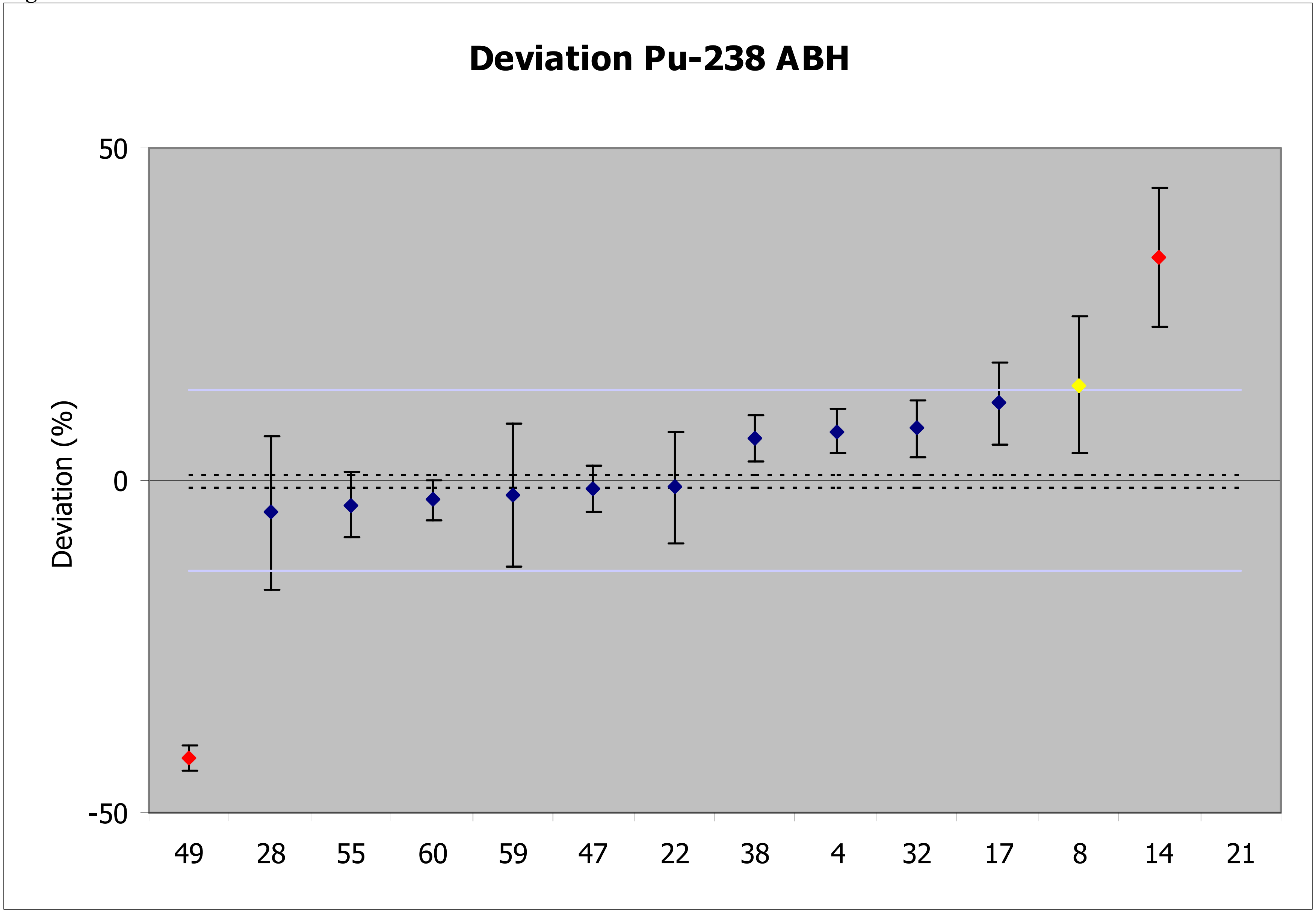


Figure 12B – Zeta score Pu-238 ABH

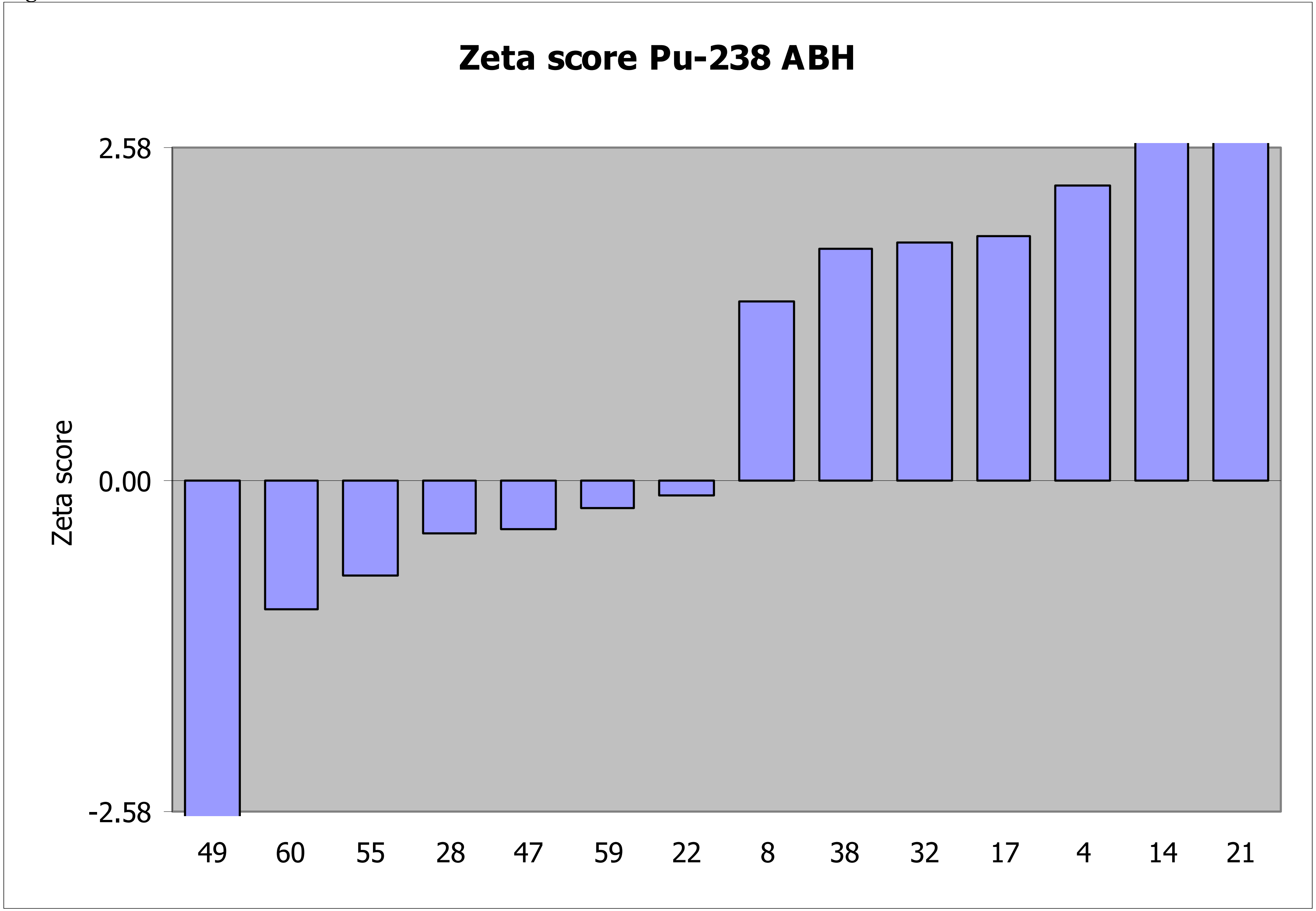


Figure 12C – Relative uncertainty Pu-238 ABH

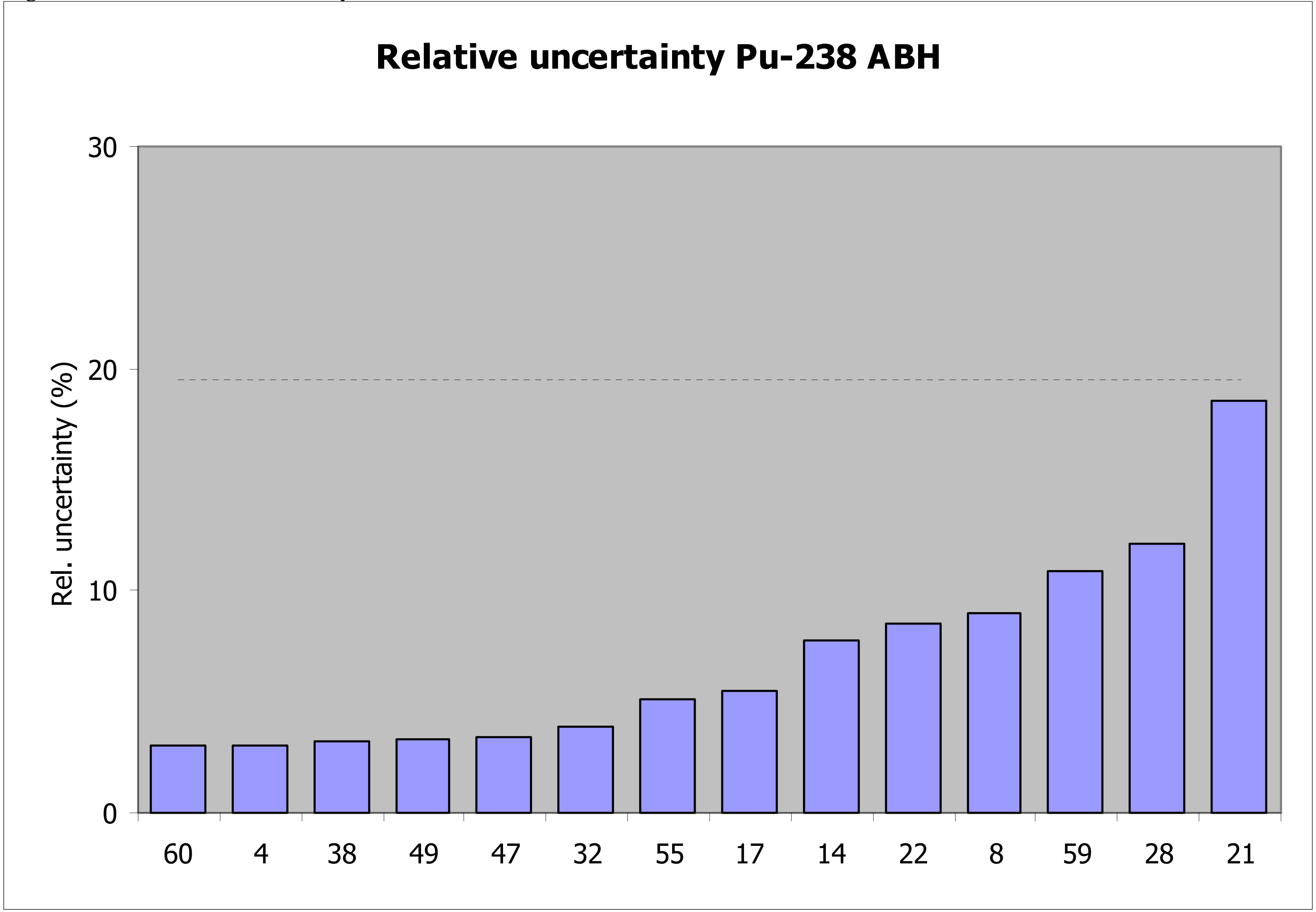


Figure 12D – Kiri plot Pu-238 ABH

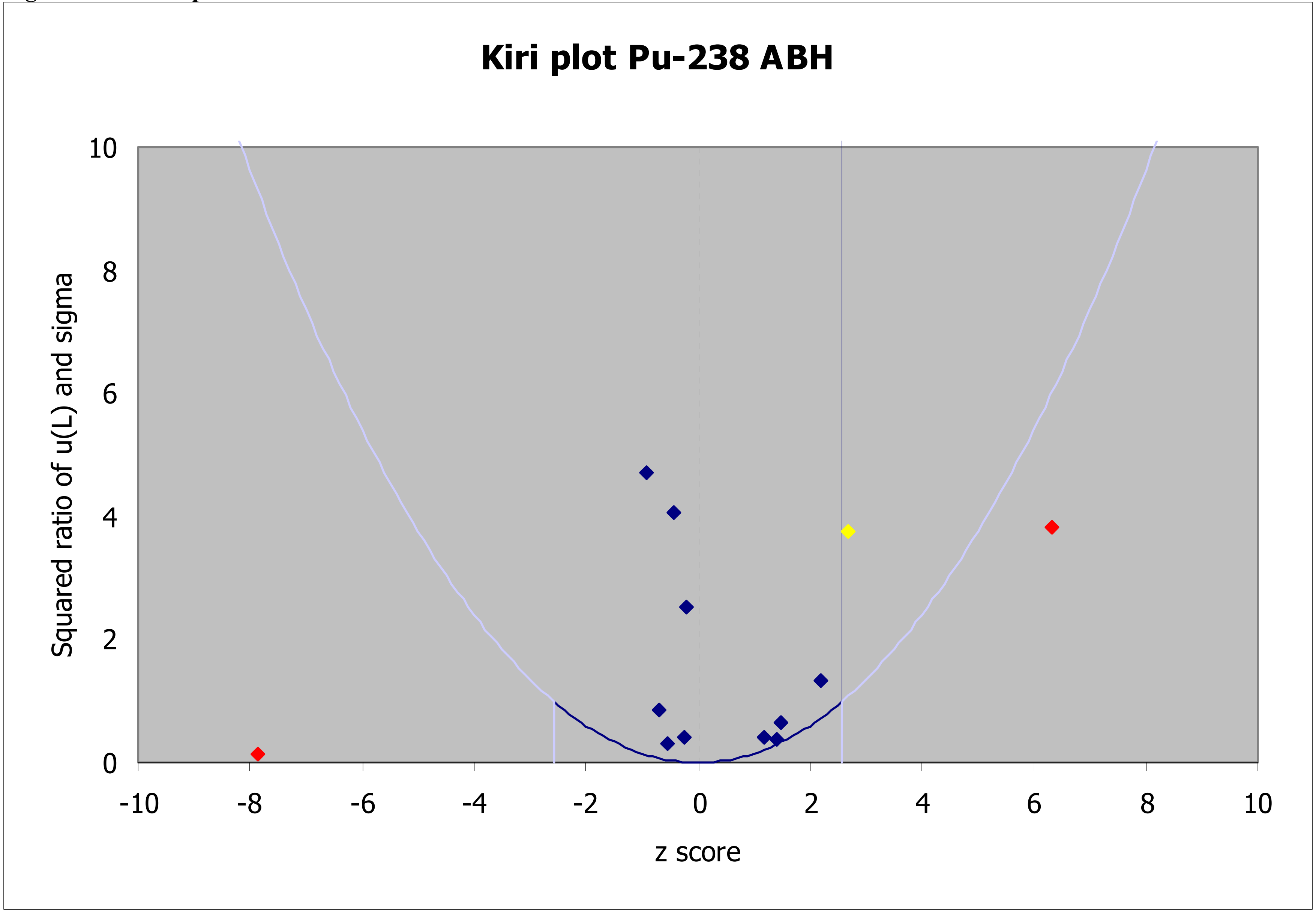


Figure 13A – Deviation Pu-239 ABH

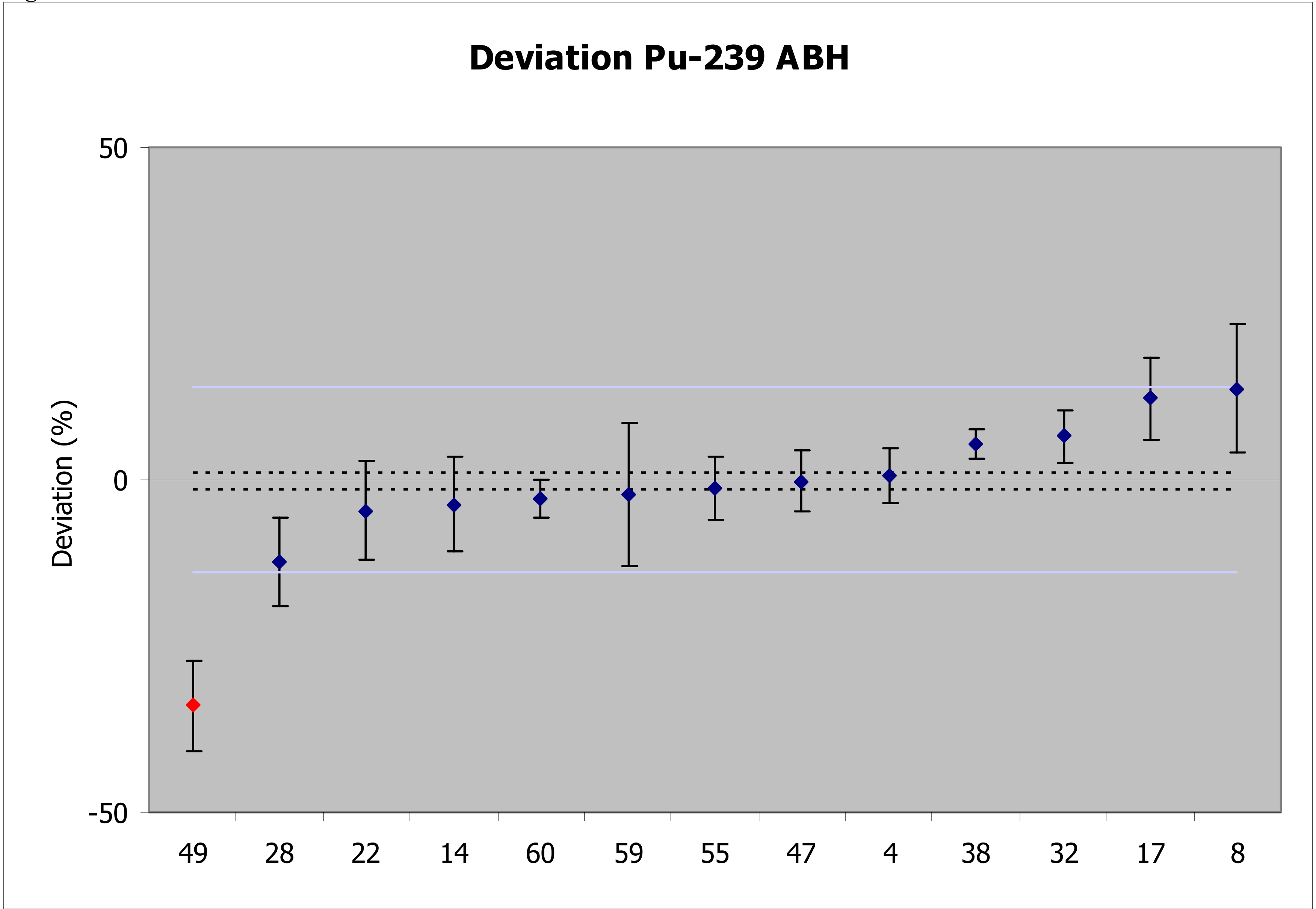


Figure 13B – Zeta score Pu-239 ABH

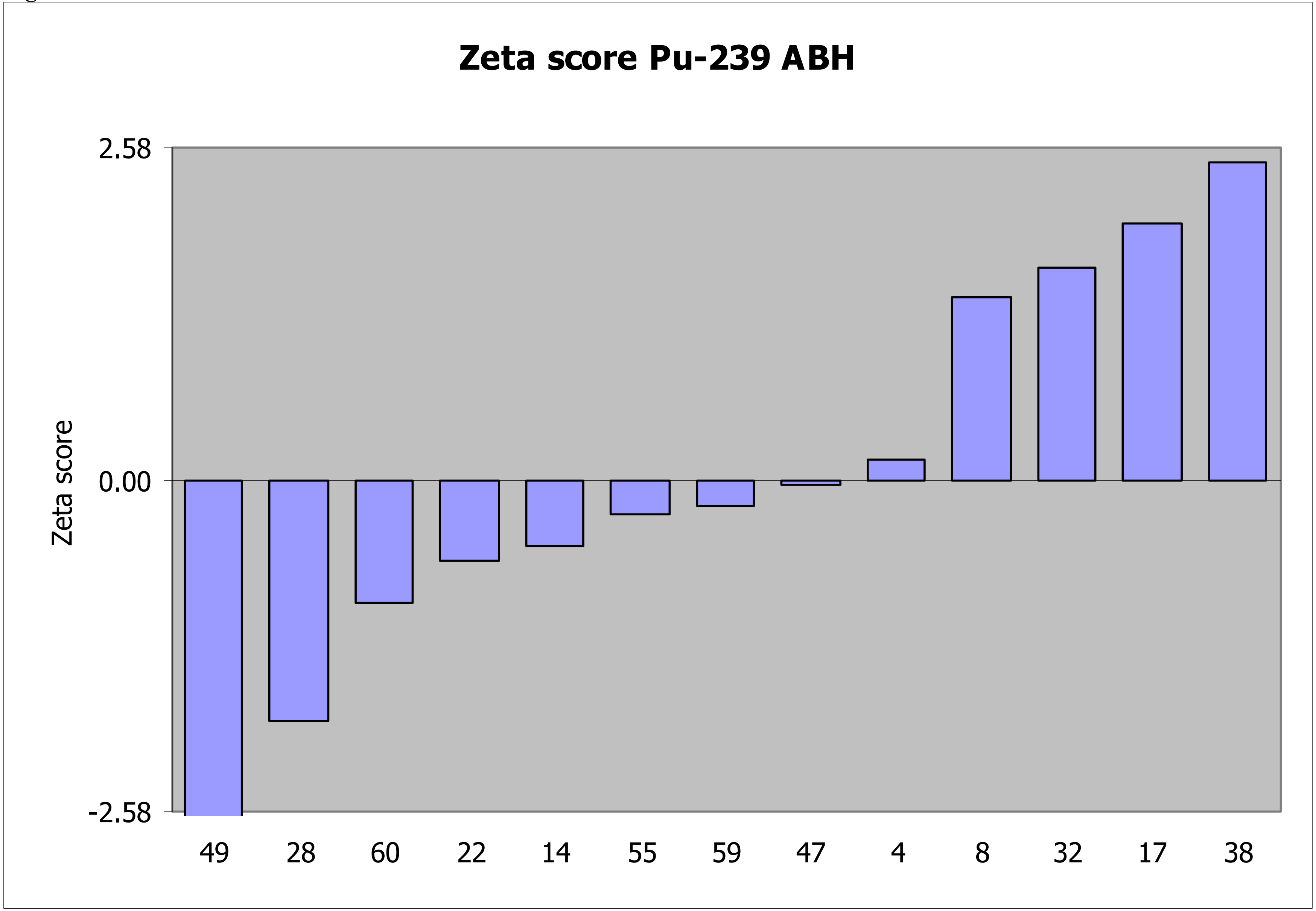


Figure 13C – Relative uncertainty Pu-239 ABH

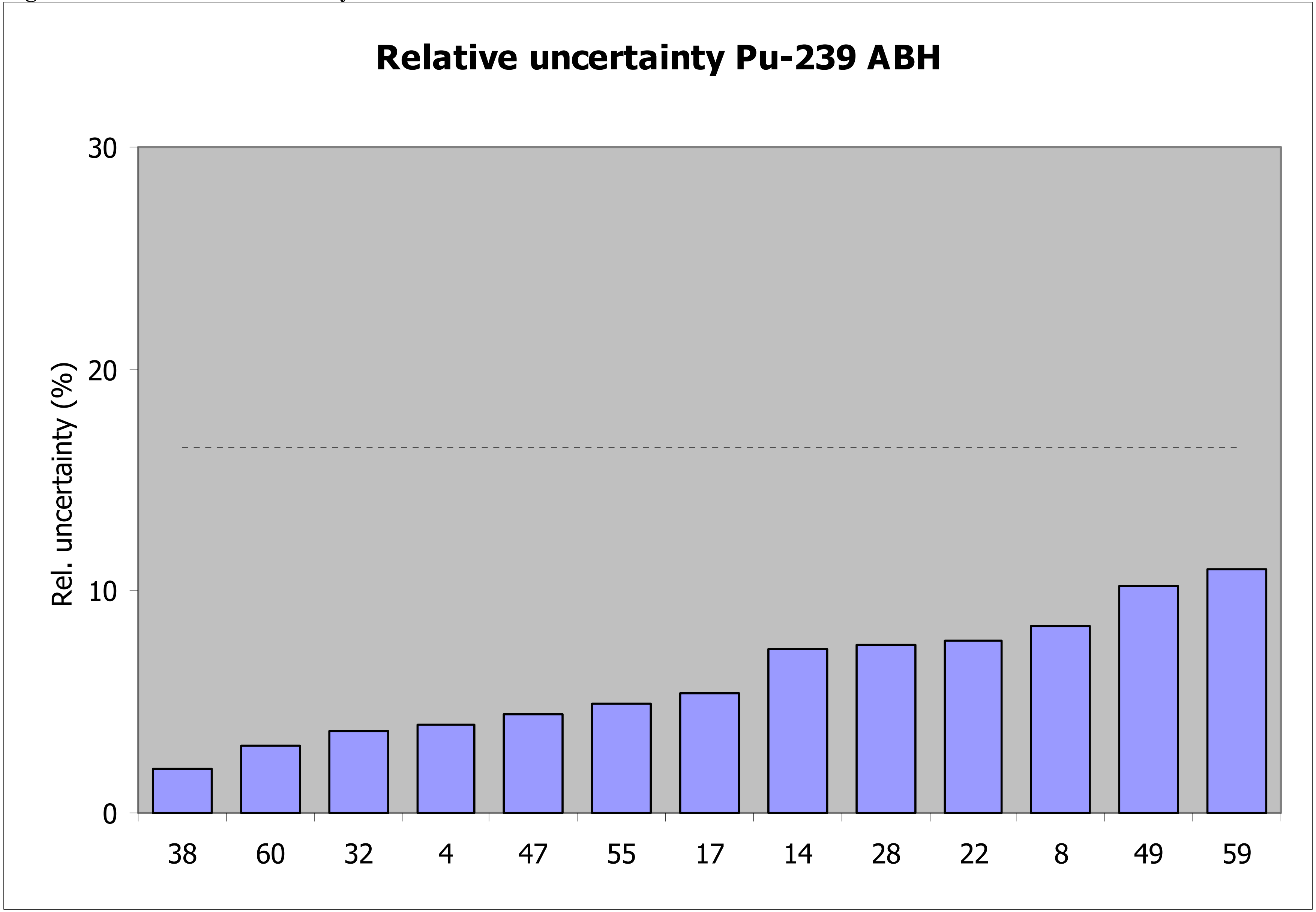


Figure 13D – Kiri plot Pu-239 ABH

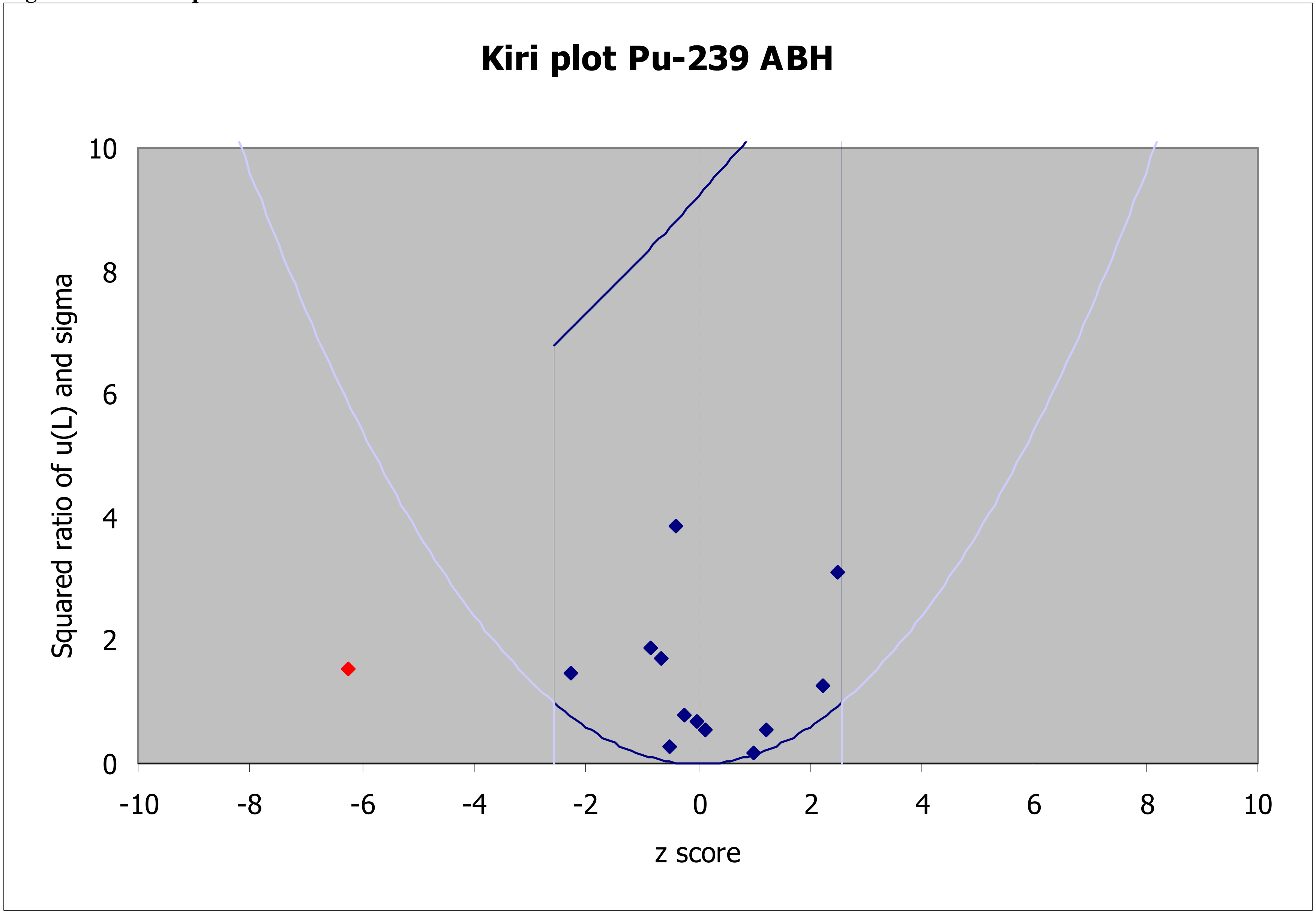


Figure 14A – Deviation Am-241 ABH

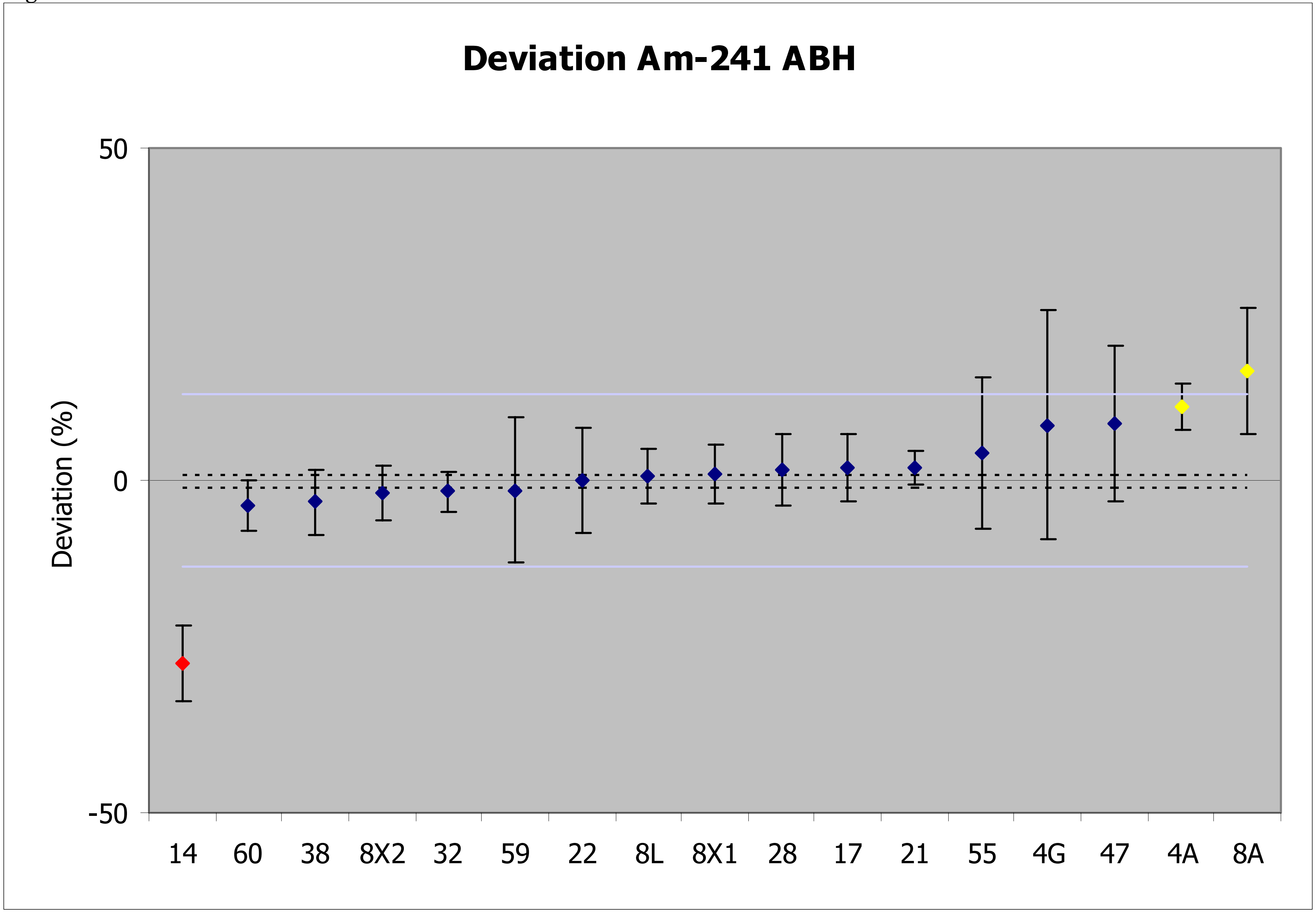


Figure 14B – Zeta score Am-241 ABH

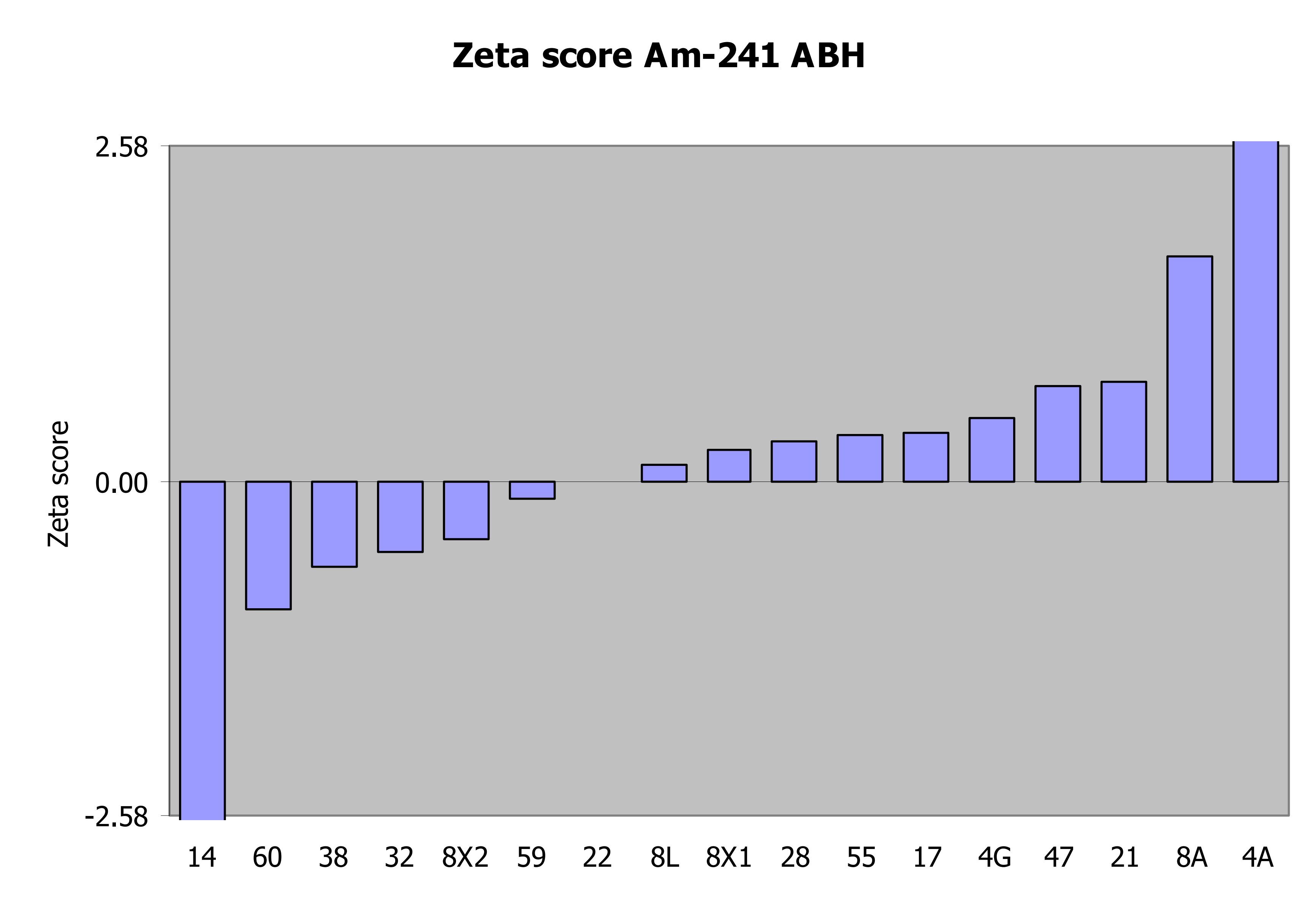


Figure 14C – Relative uncertainty Am-241 ABH

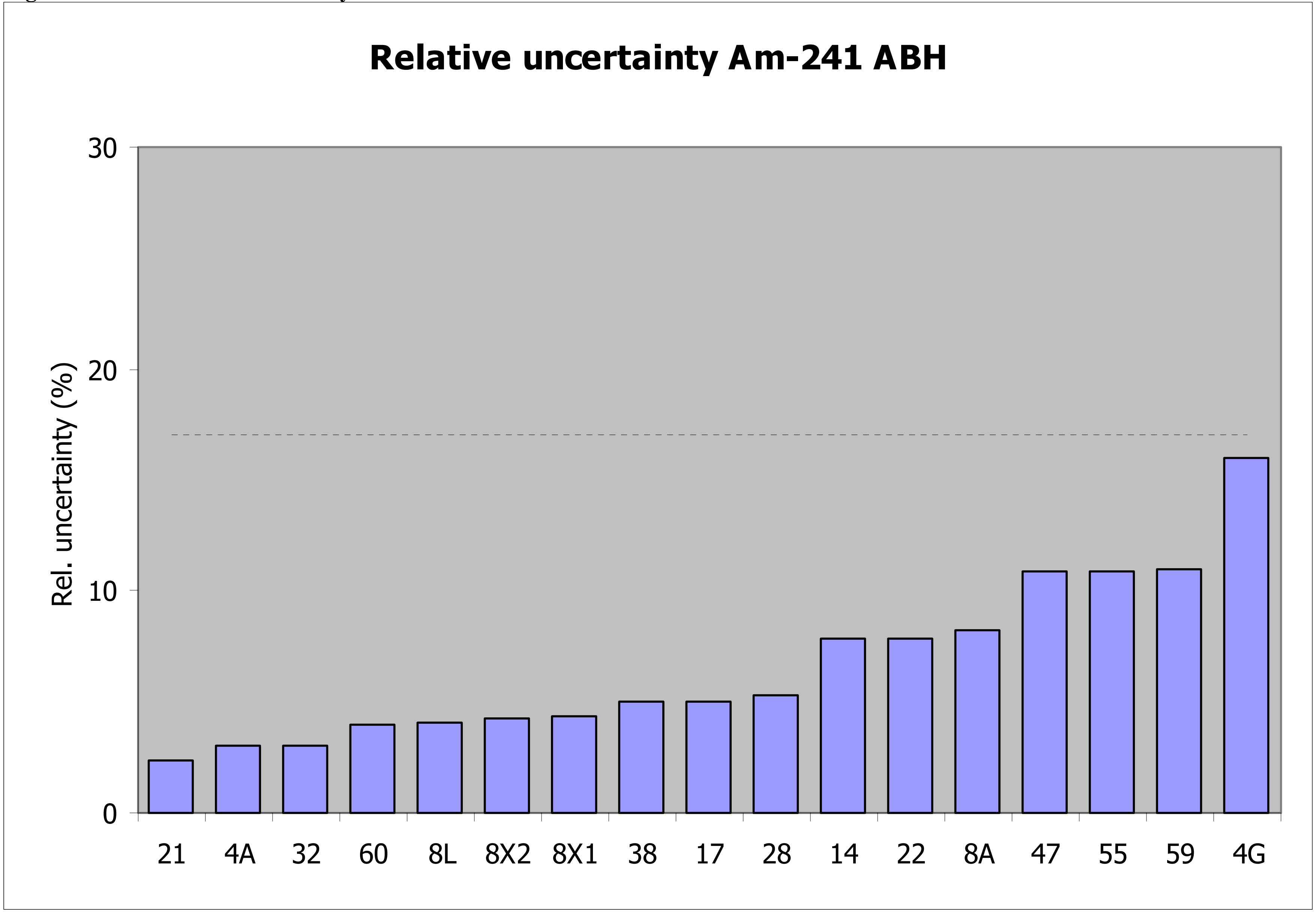


Figure 14D – Kiri plot Am-241 ABH

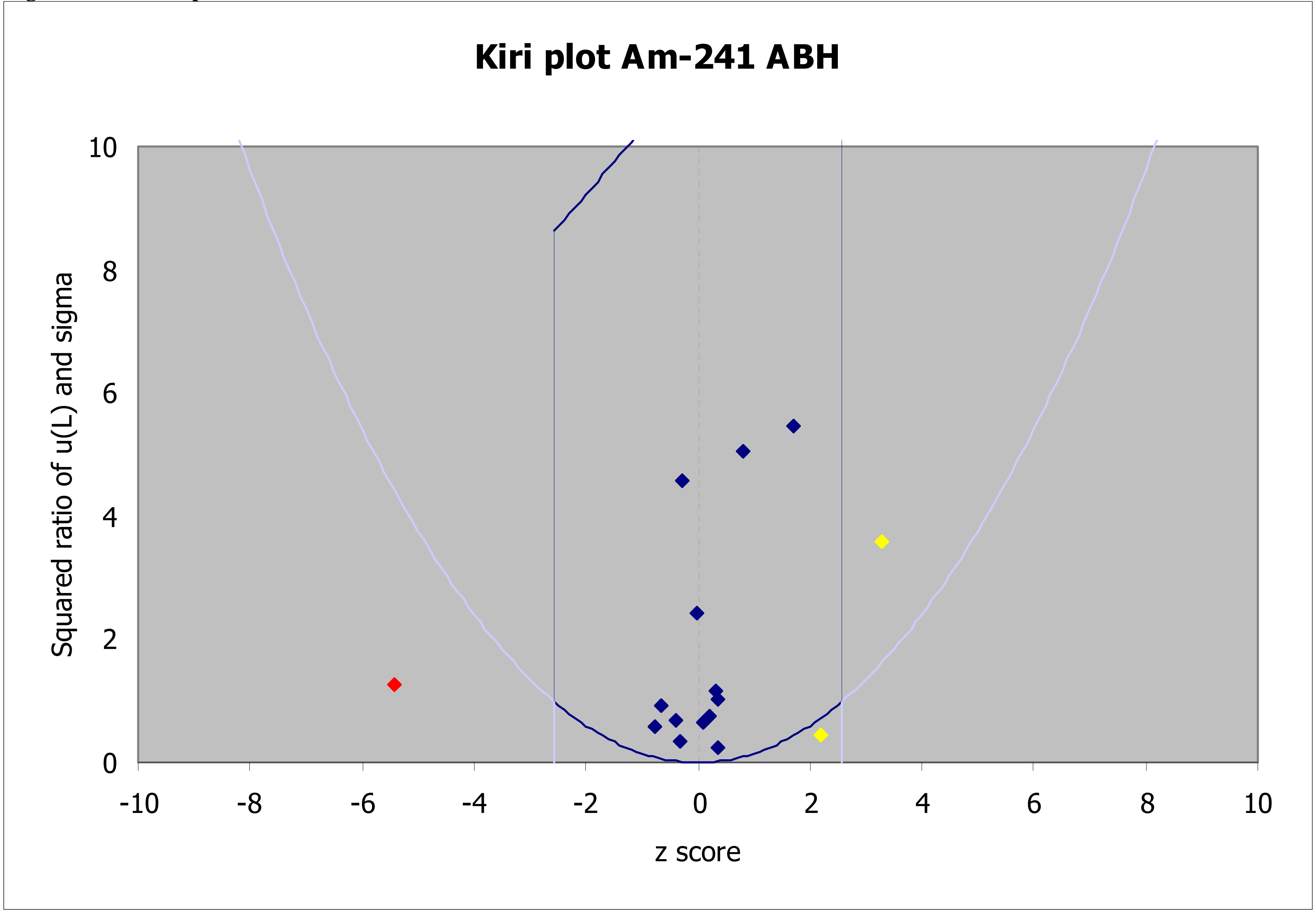


Figure 15A – Deviation Na-22 GL

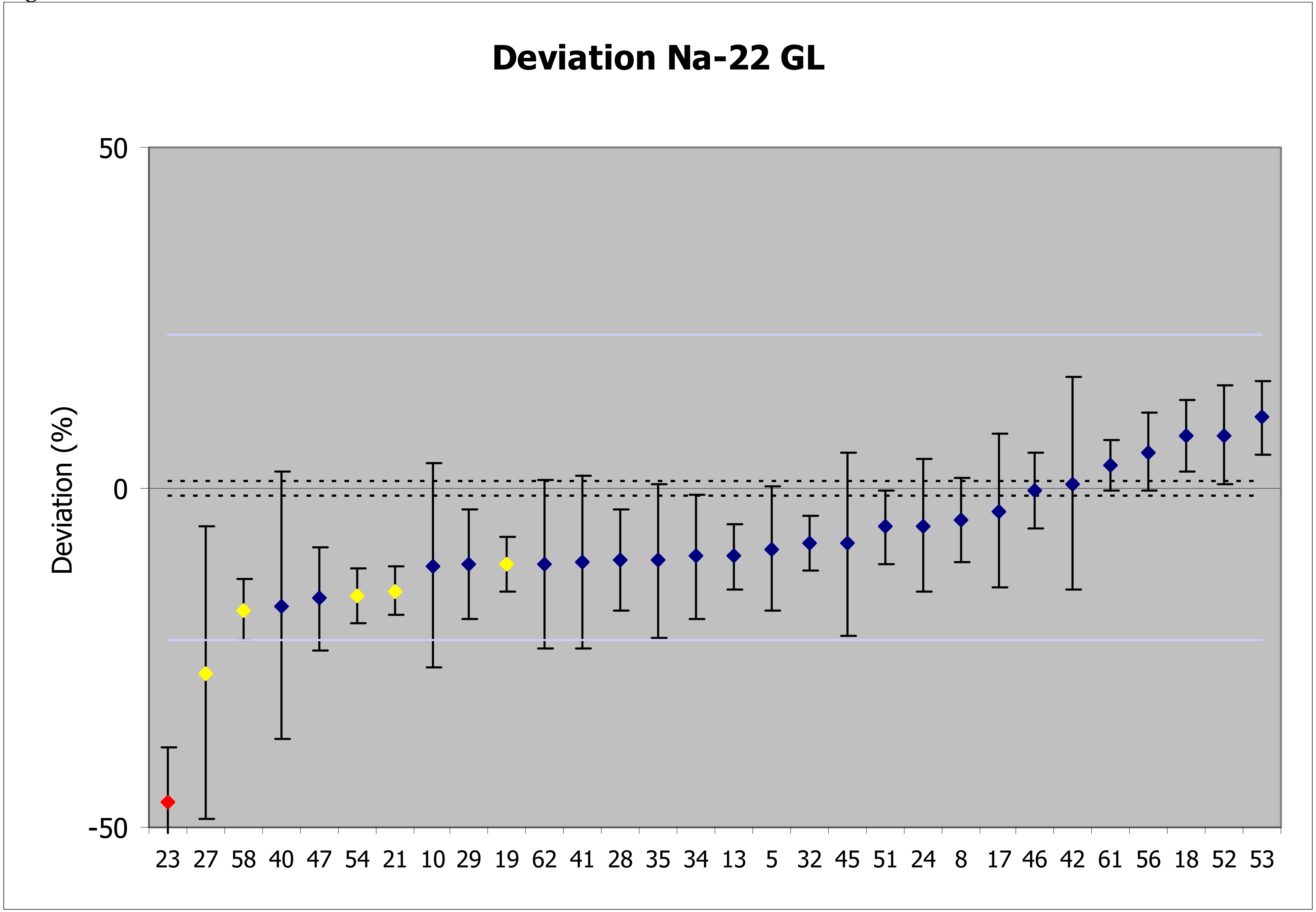


Figure 15B – Zeta score Na-22 GL

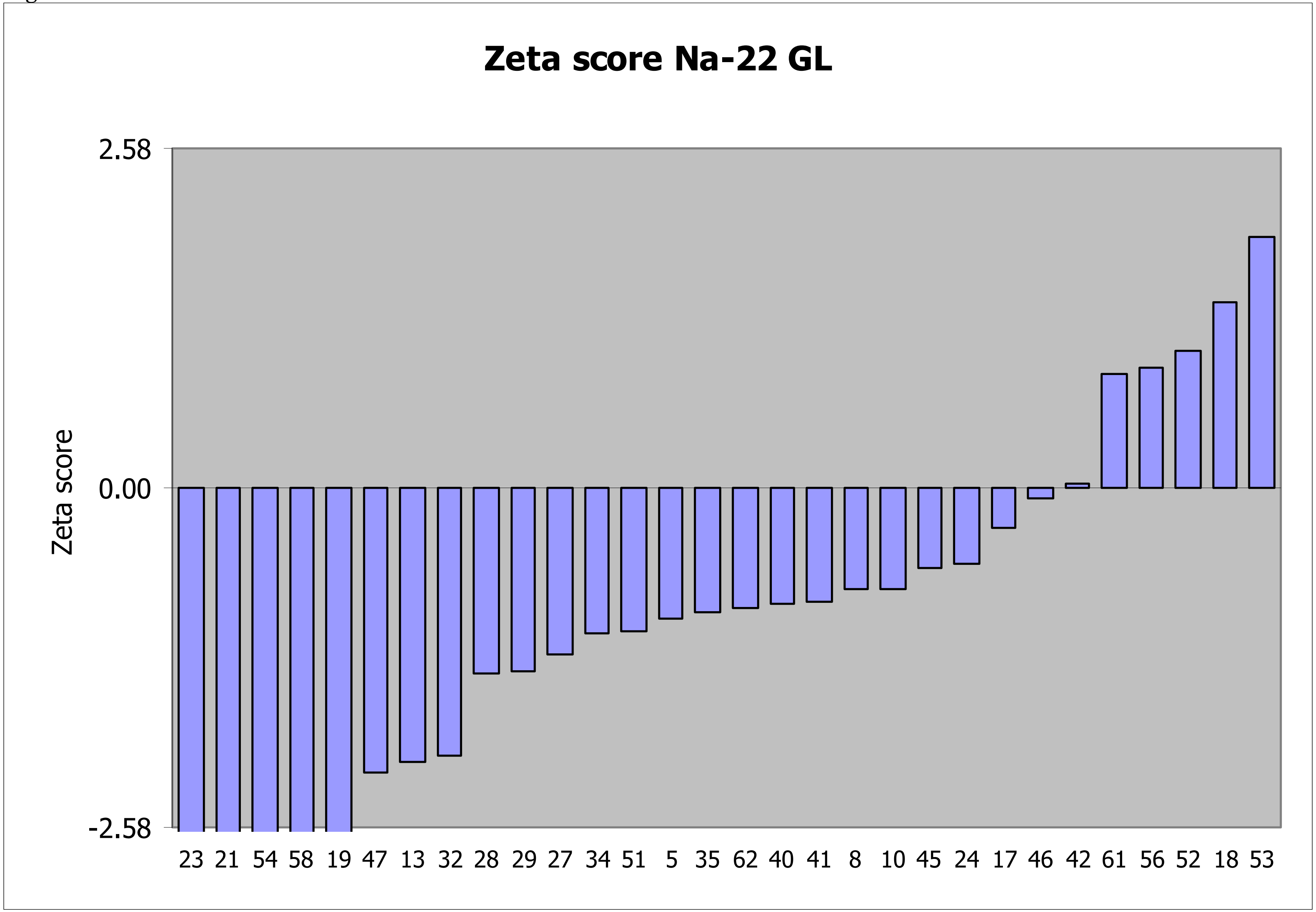


Figure 15C – Relative uncertainty Na-22 GL

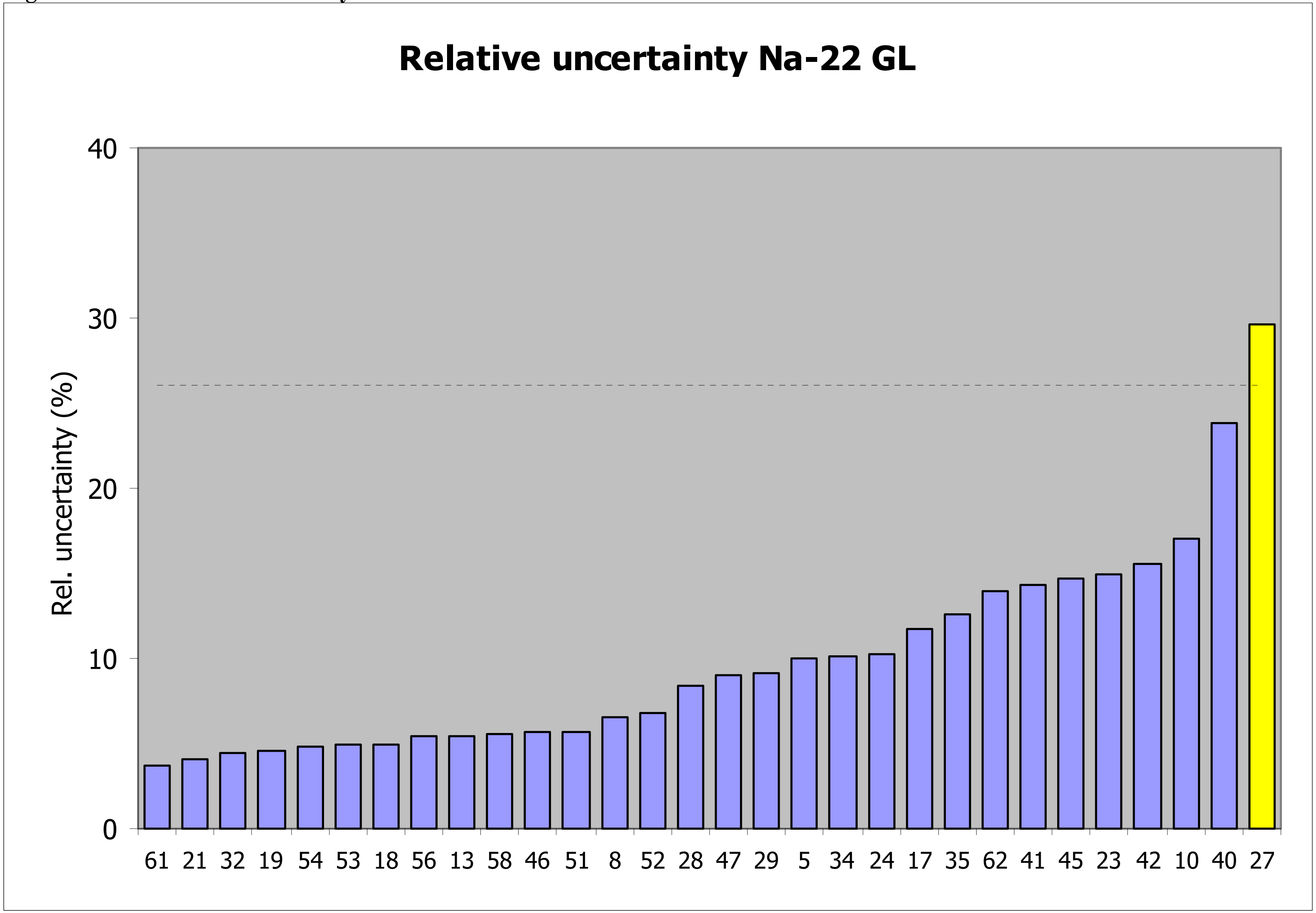


Figure 15D – Kiri plot Na-22 GL

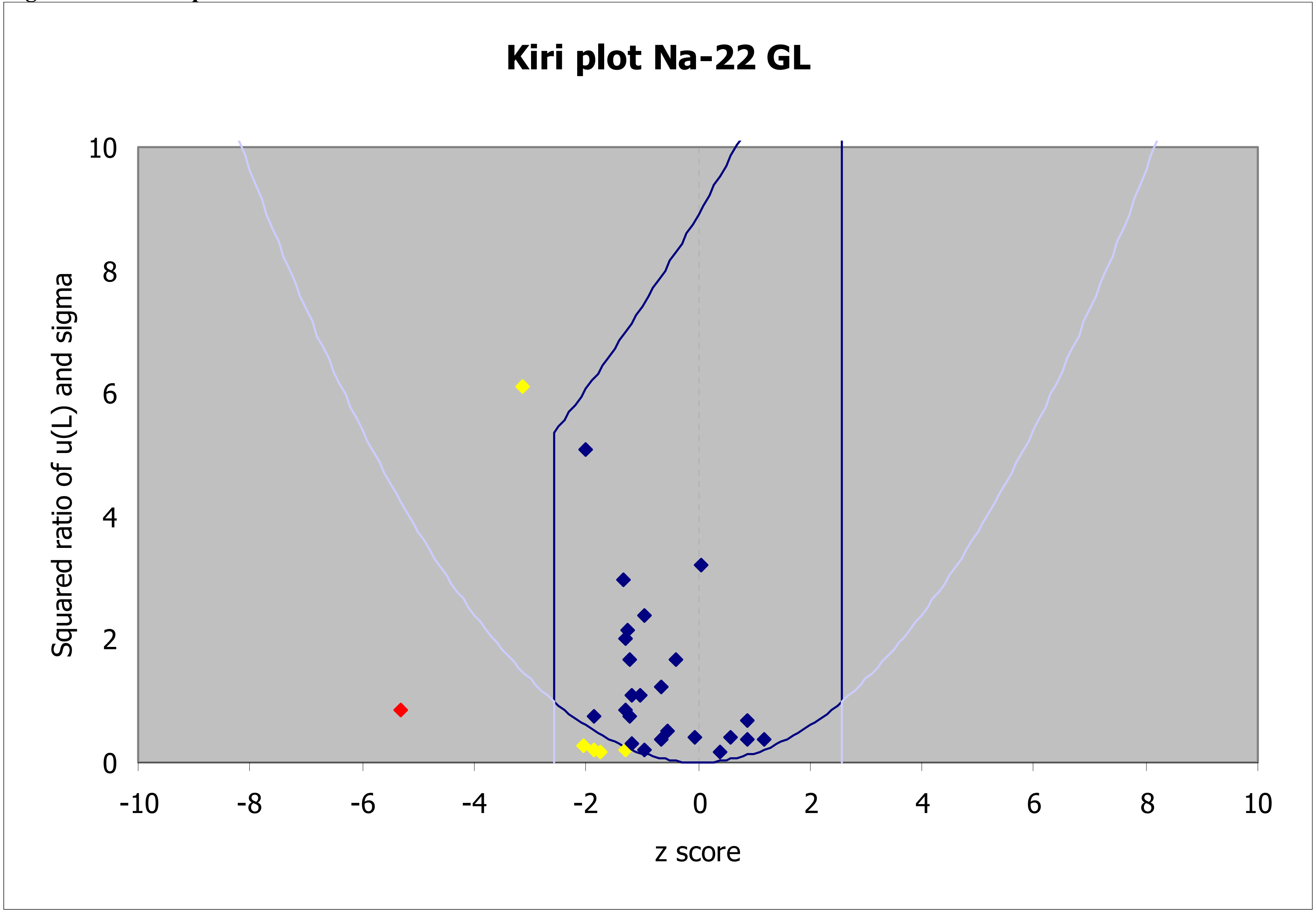


Figure 16A – Deviation Co-60 GL

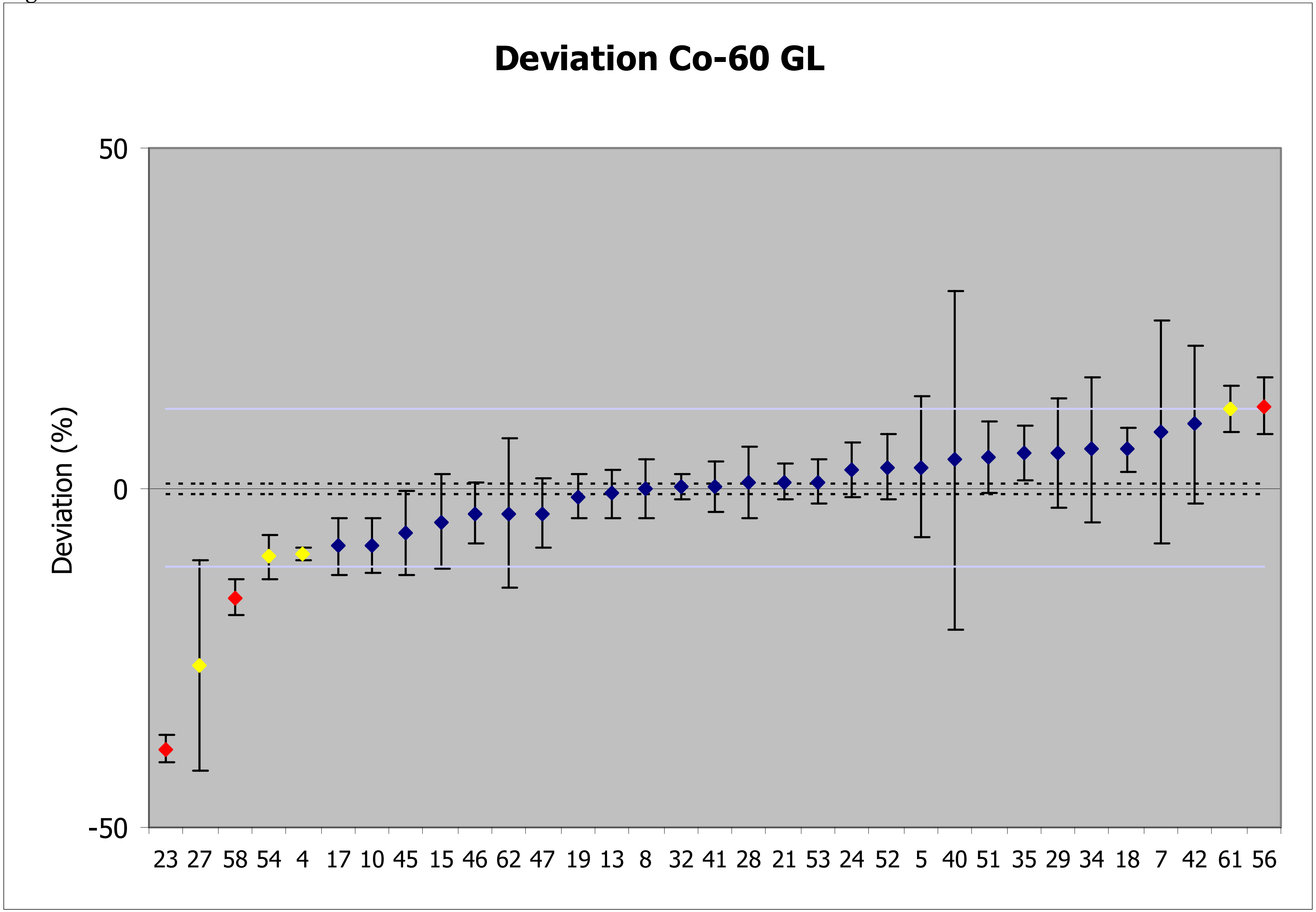


Figure 16B – Zeta score Co-60 GL

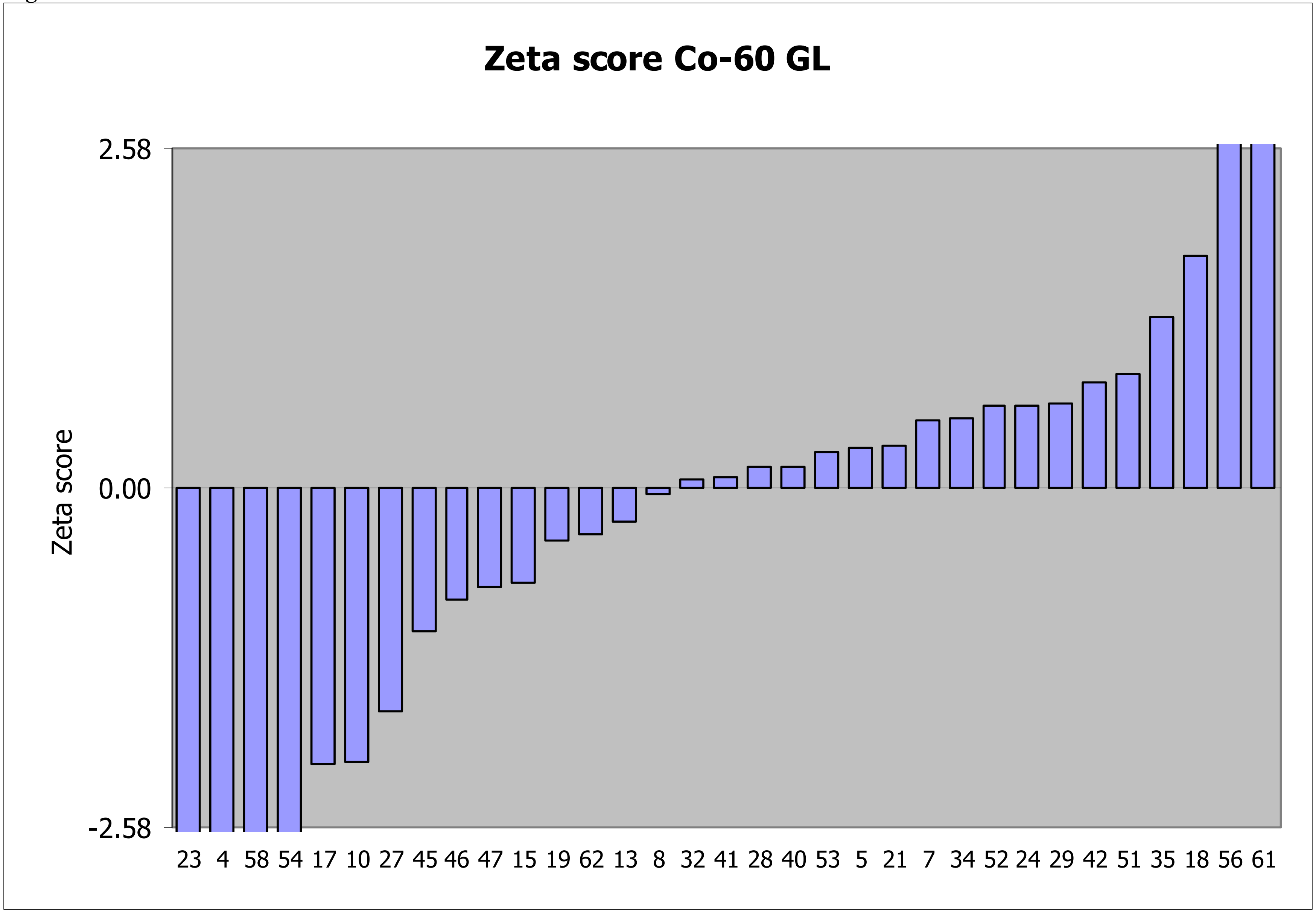


Figure 16C – Relative uncertainty Co-60 GL

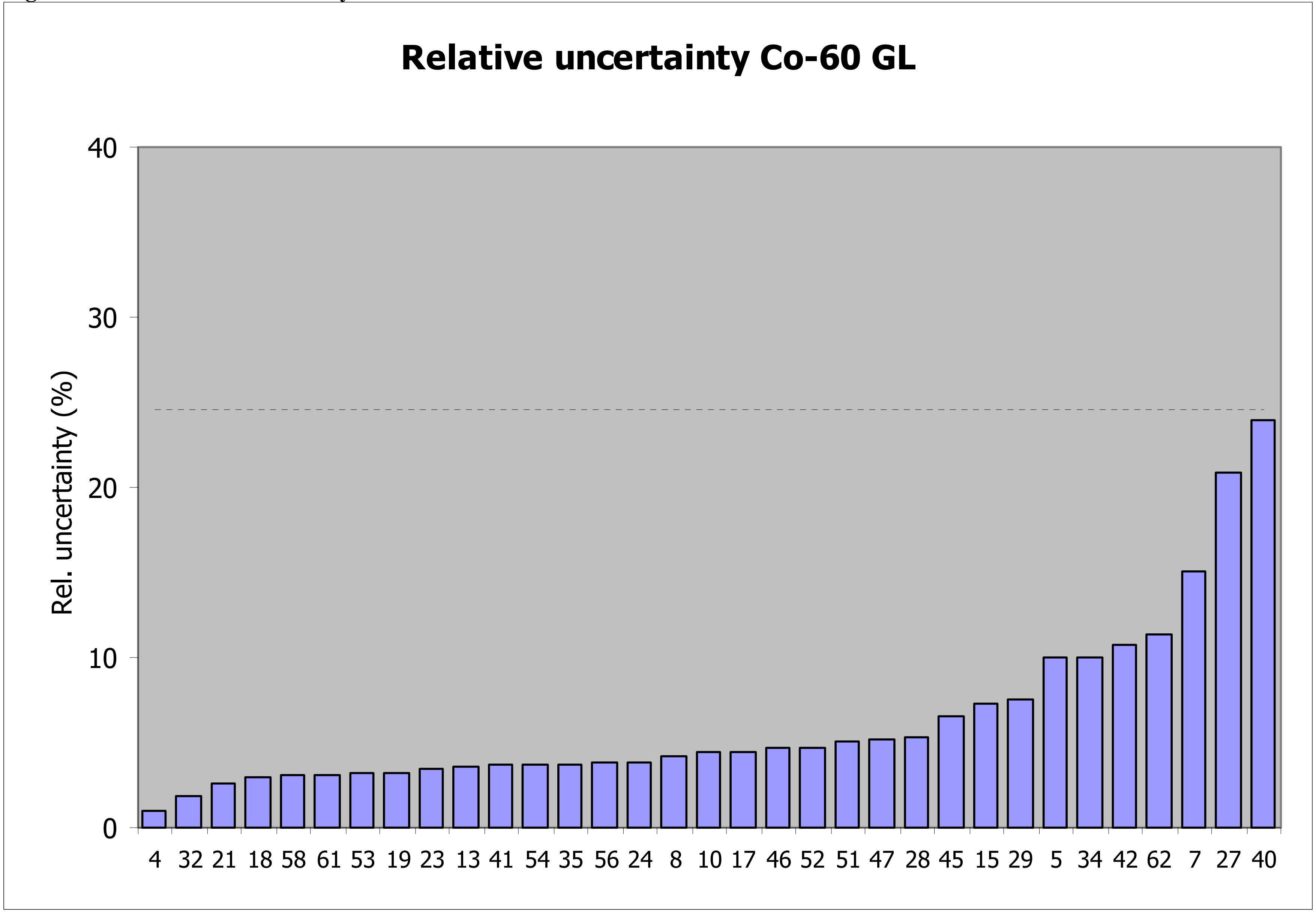


Figure 16D – Kiri plot Co-60 GL

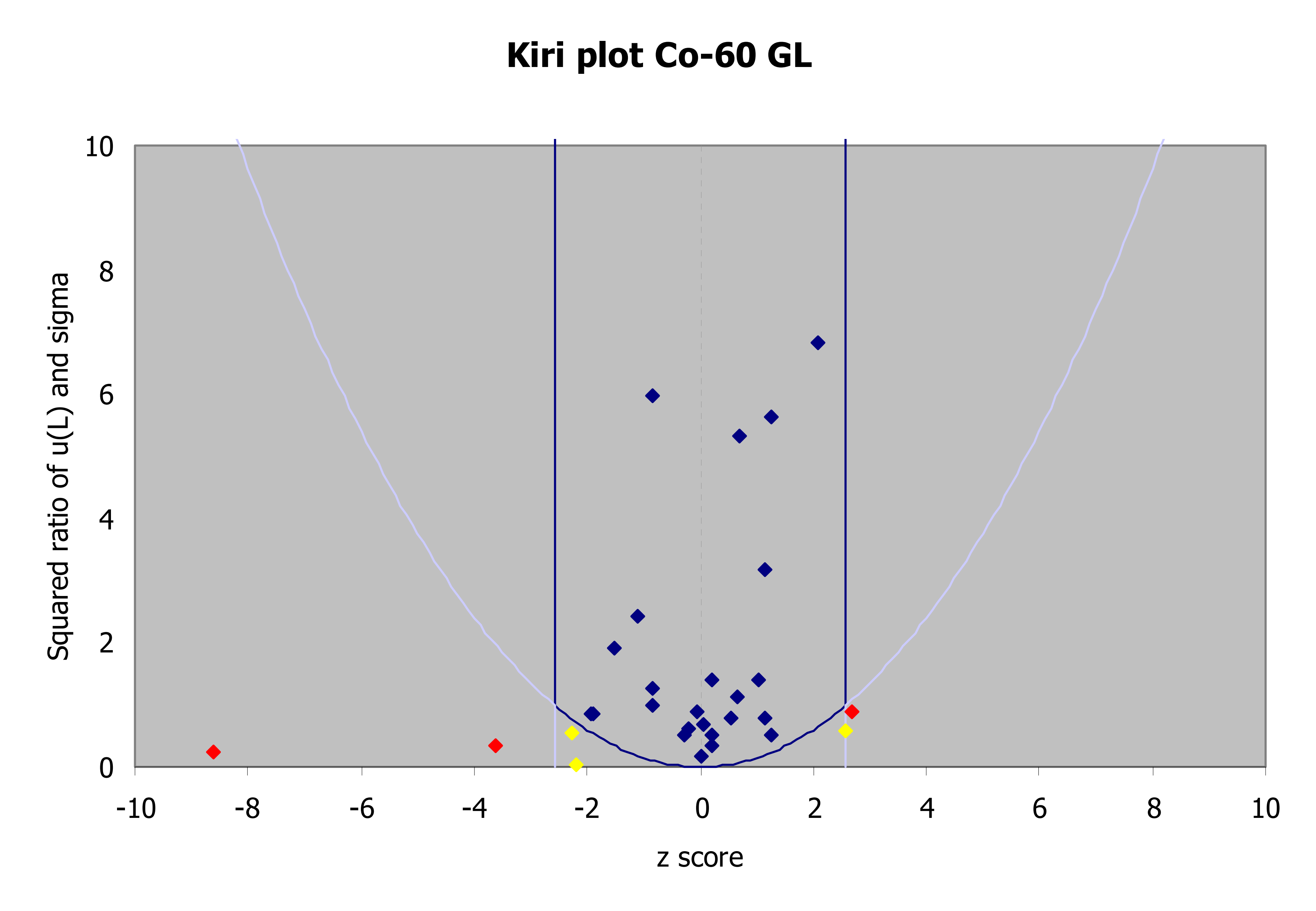


Figure 17A – Deviation Y-88 GL

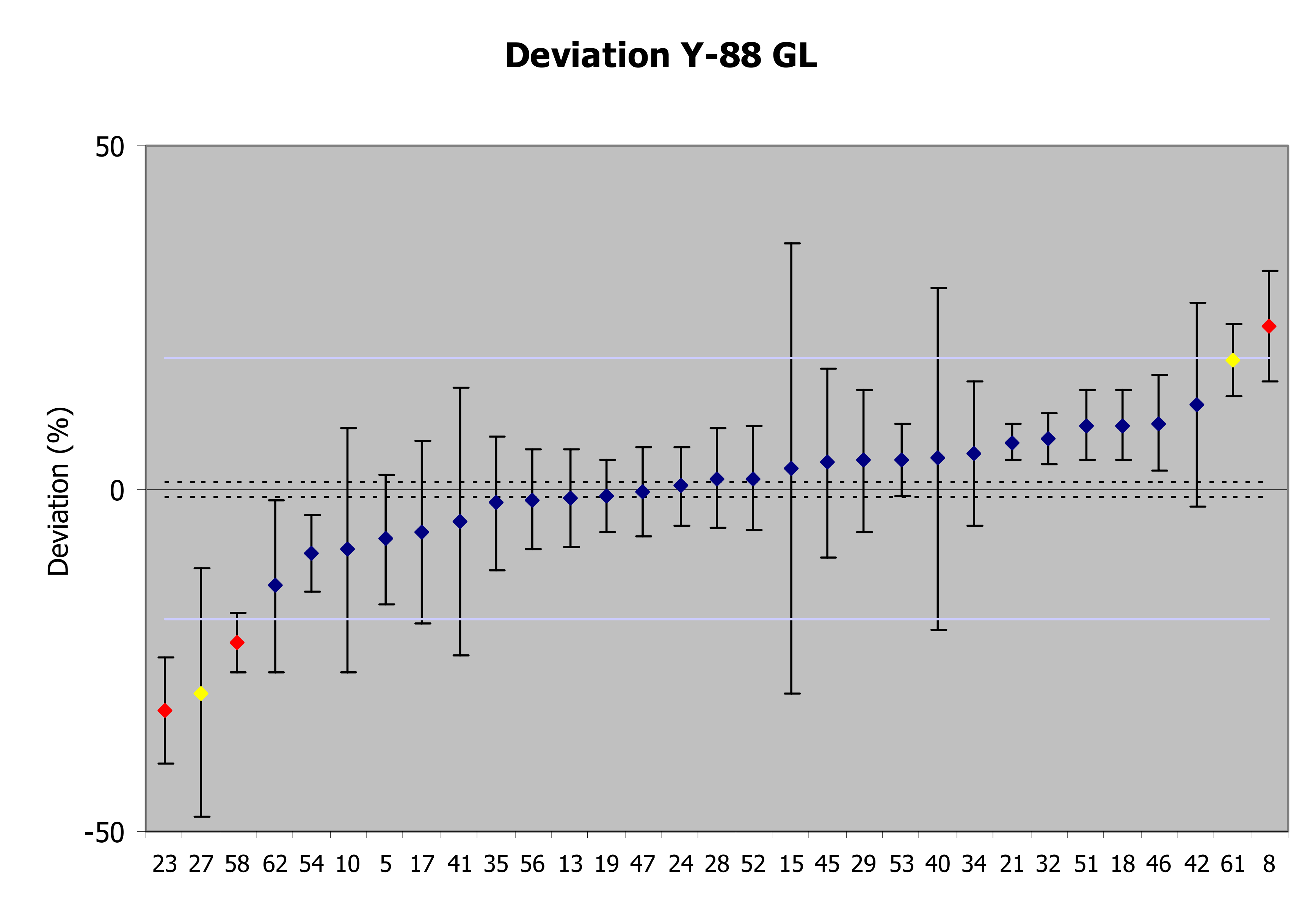


Figure 17B – Zeta score Y-88 GL

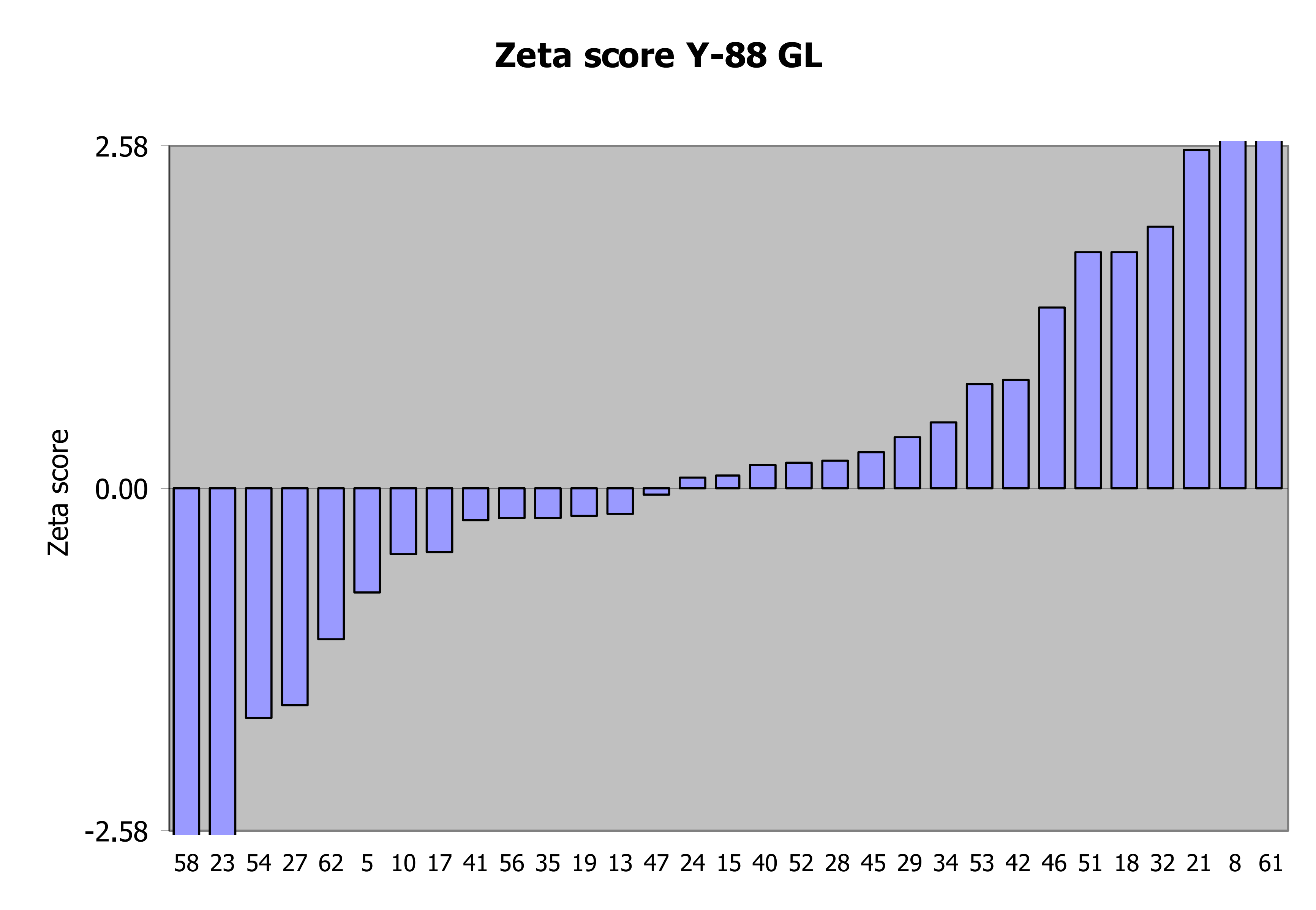


Figure 17C – Relative uncertainty Y-88 GL

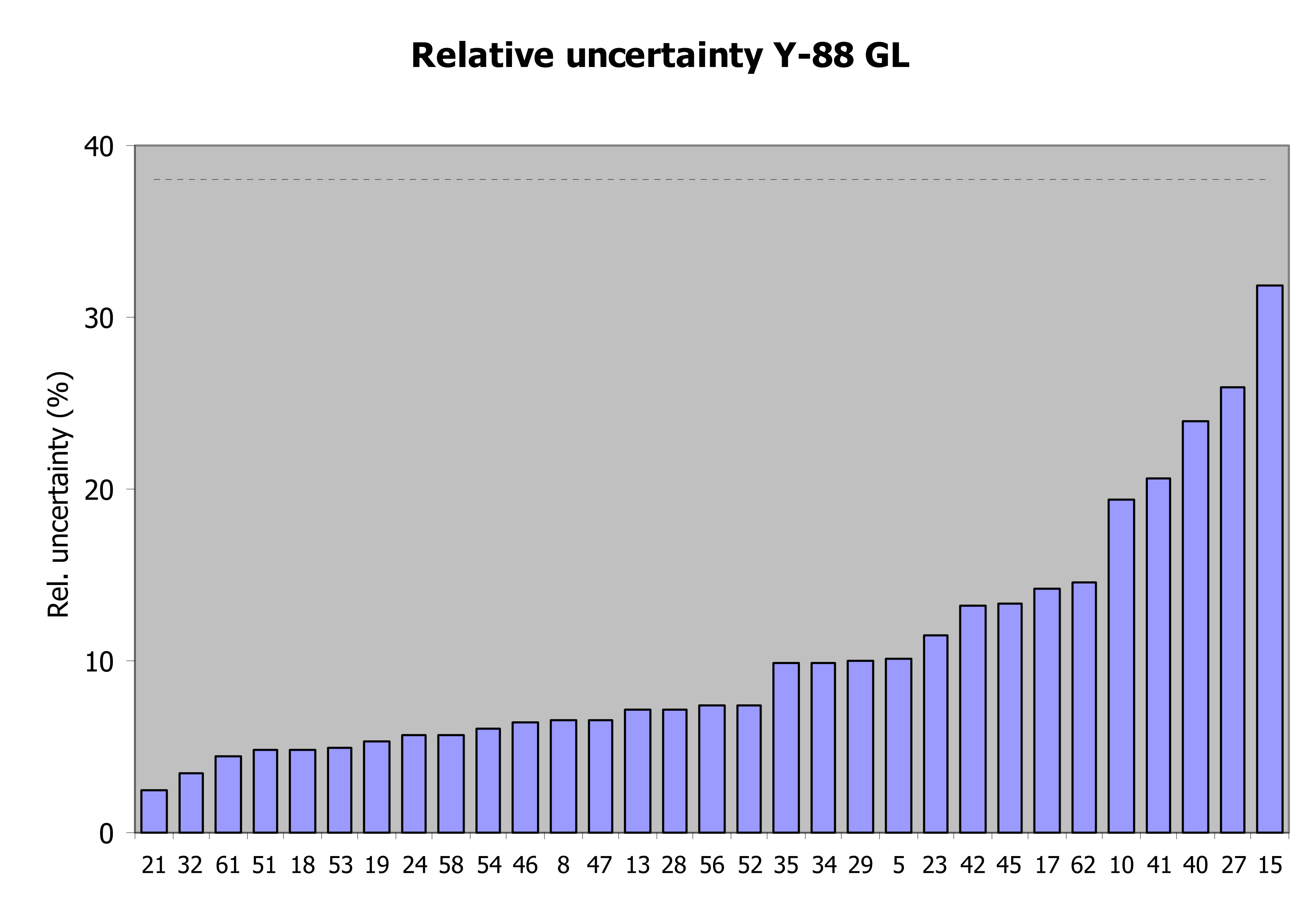


Figure 17D – Kiri plot Y-88 GL

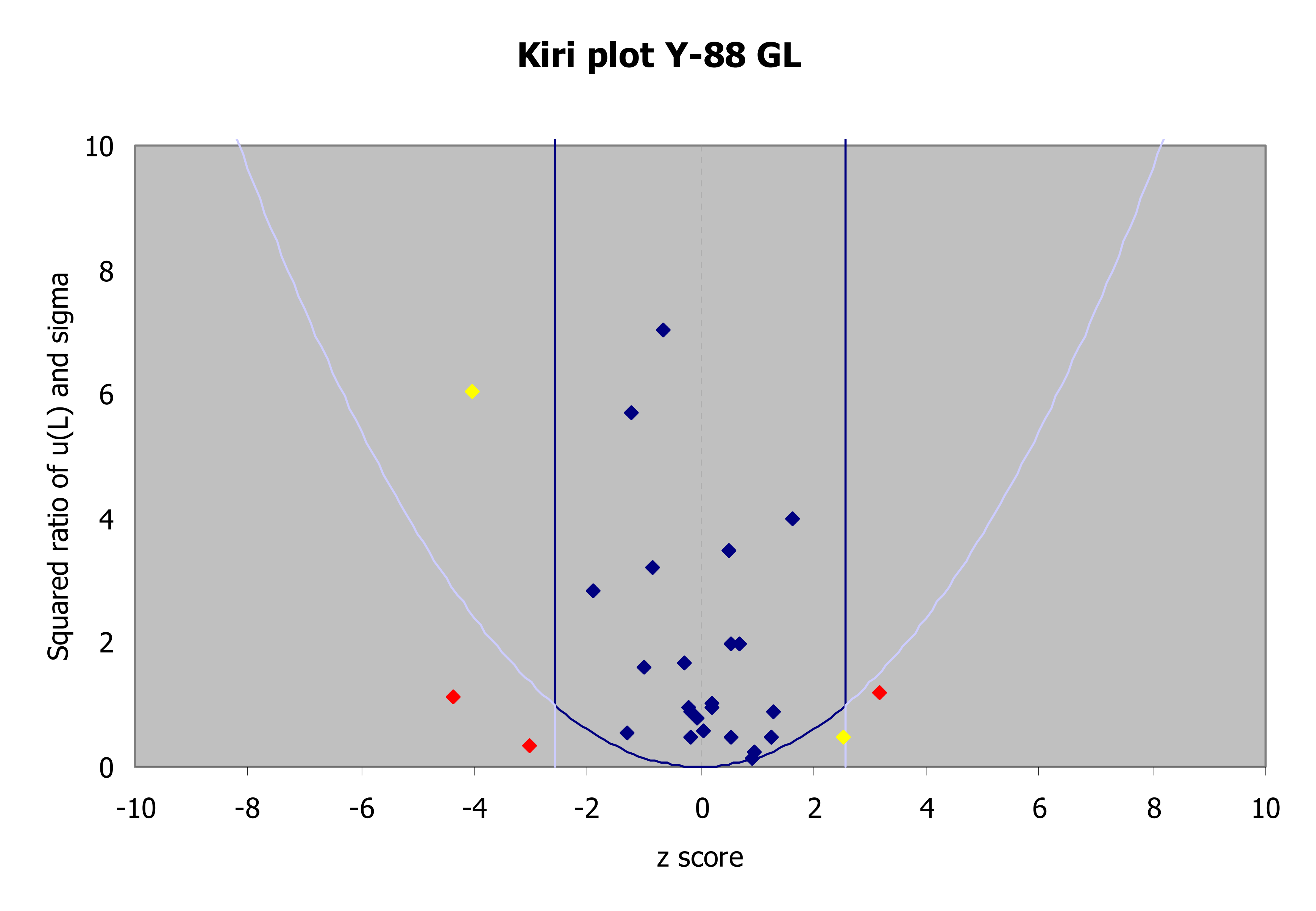


Figure 18A – Deviation Zr-95 GL

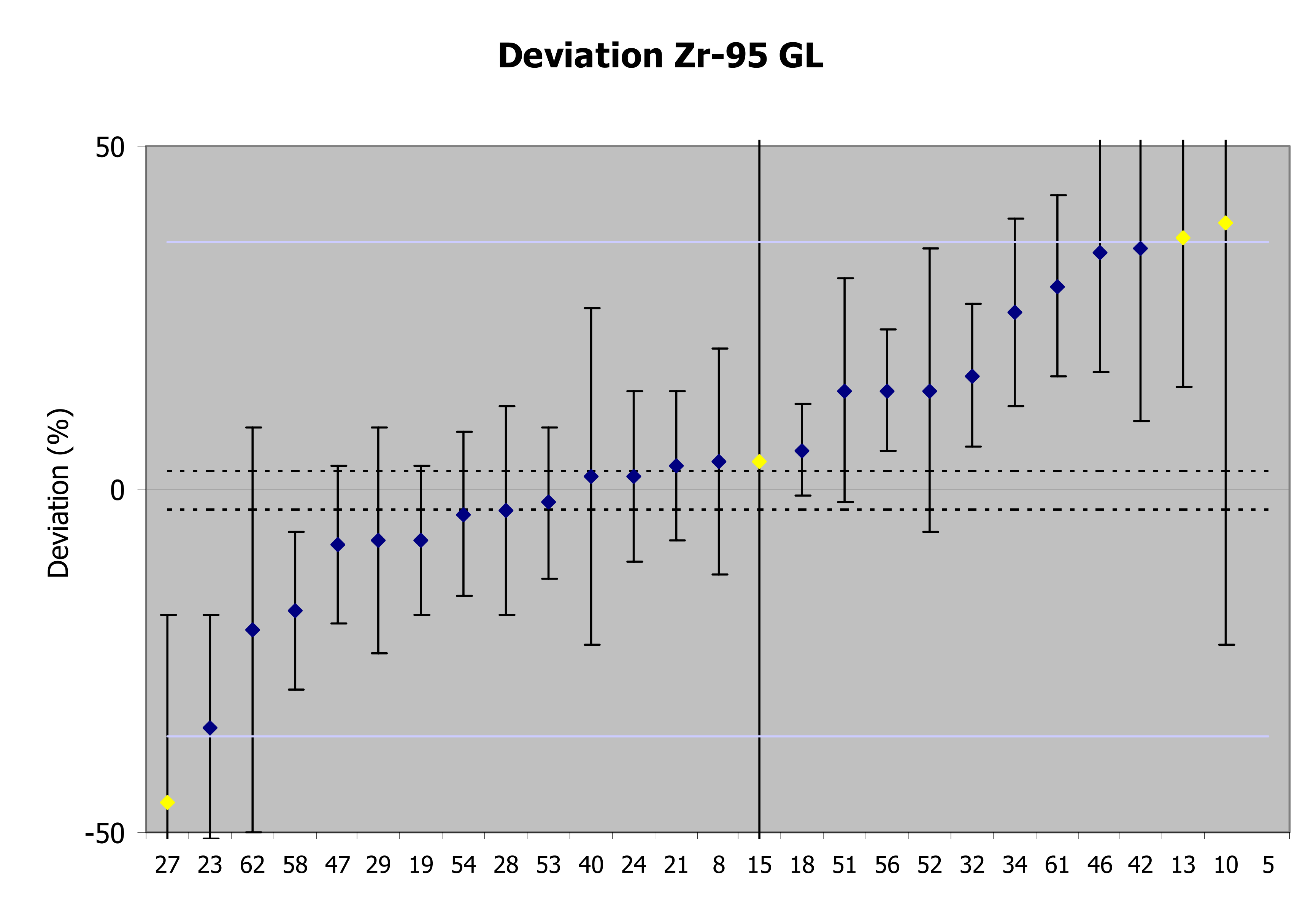


Figure 18B – Zeta score Zr-95 GL

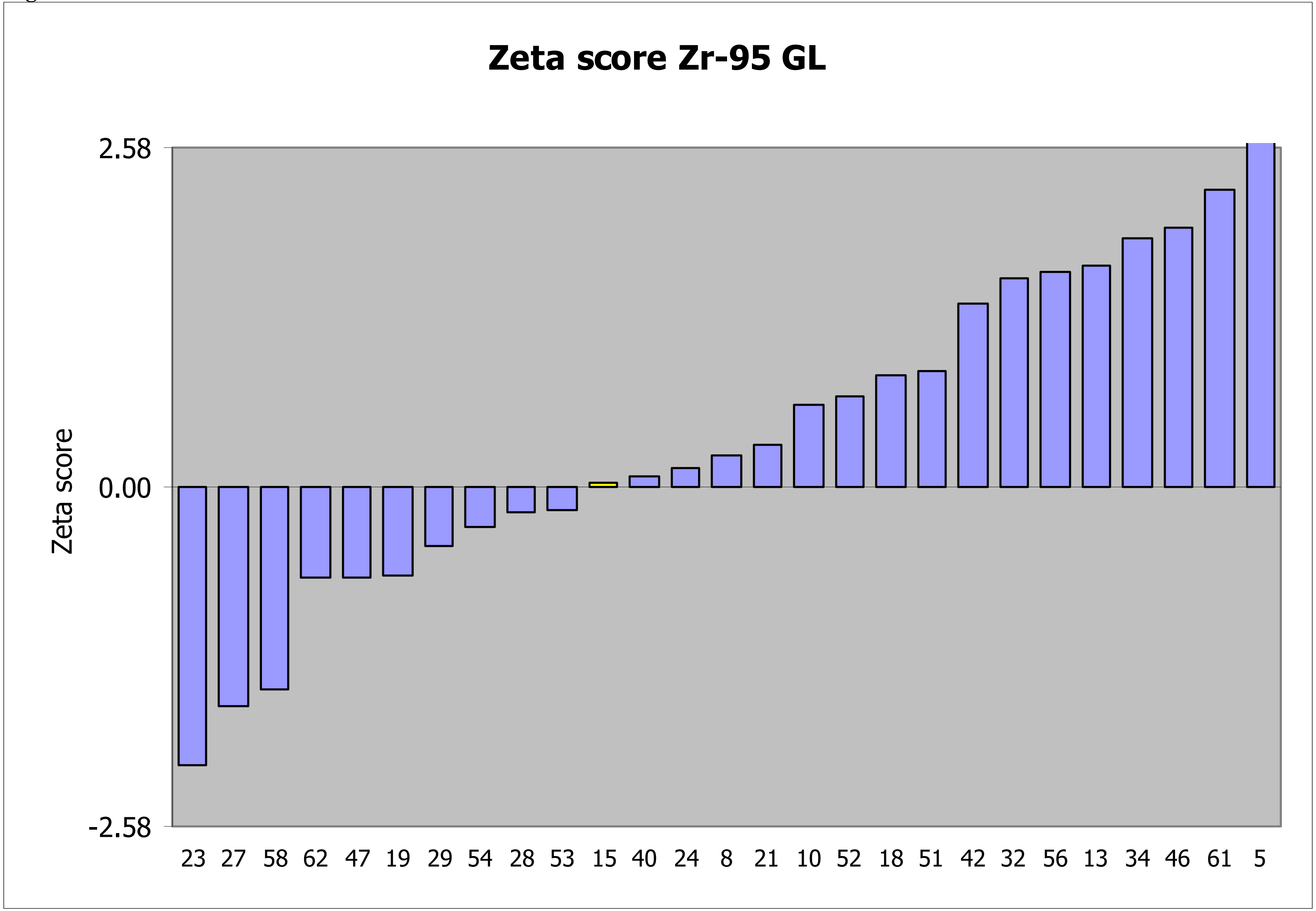


Figure 18C – Relative uncertainty Zr-95 GL

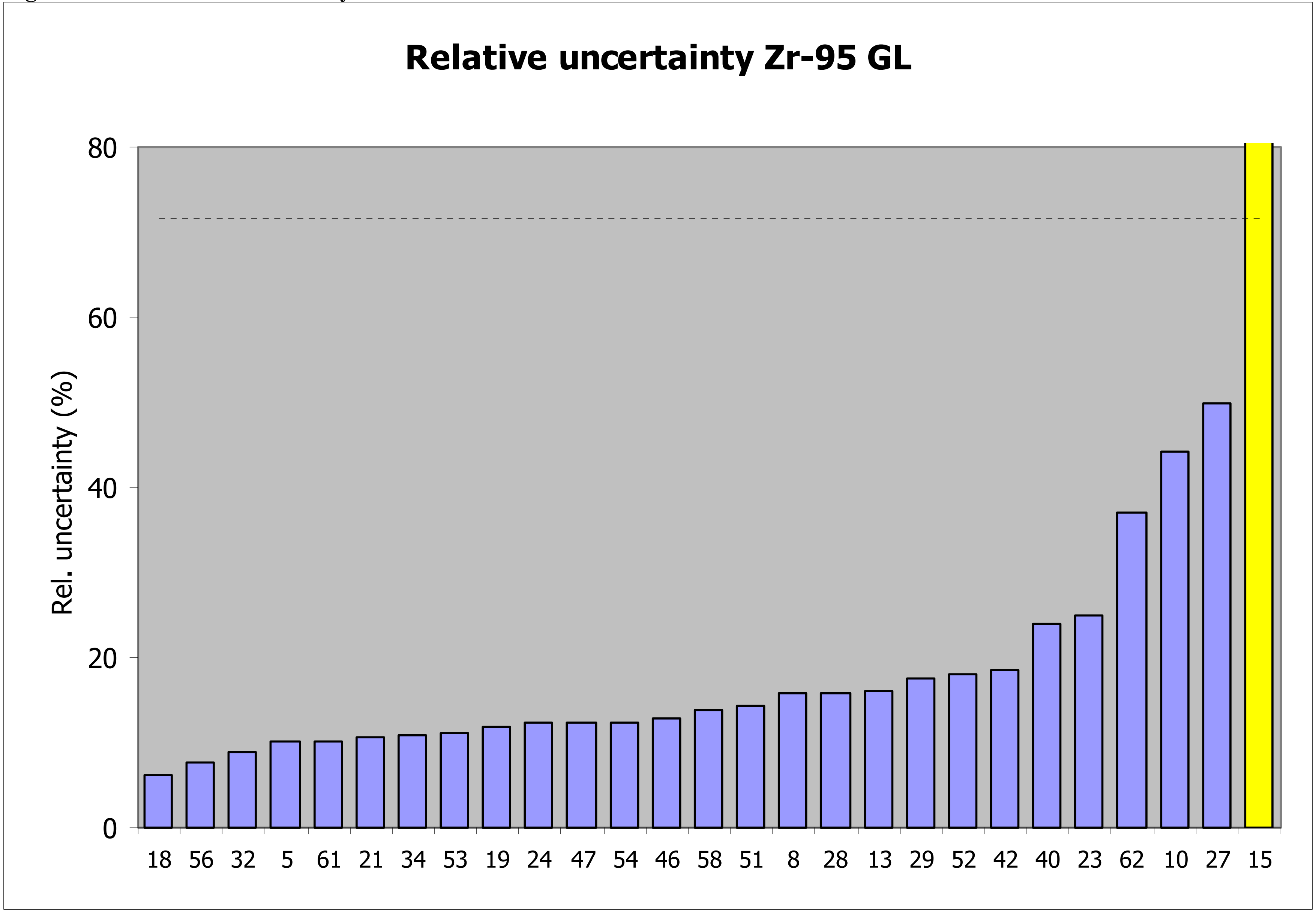


Figure 18D – Kiri plot Zr-95 GL

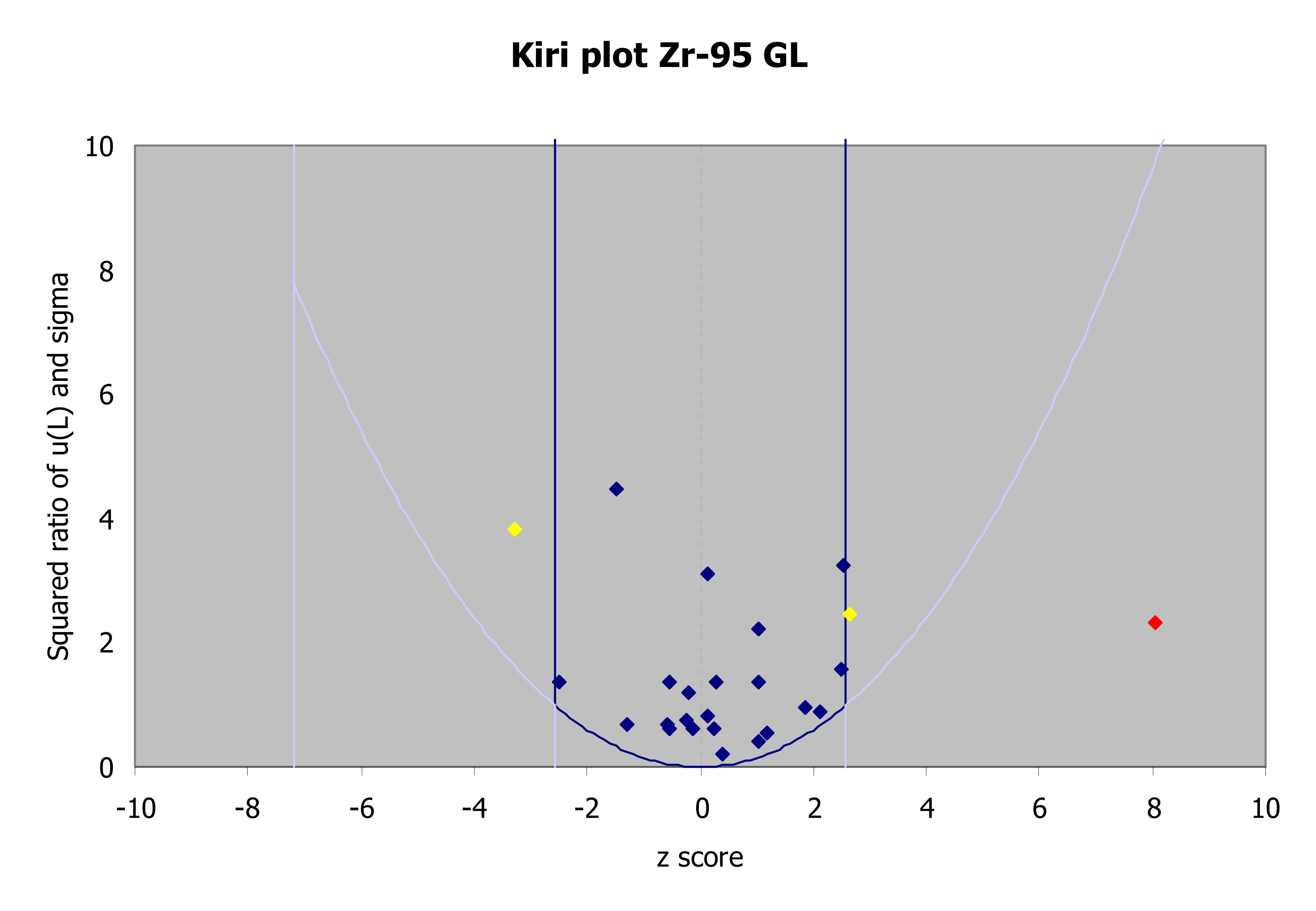


Figure 19A – Deviation Nb-95 GL

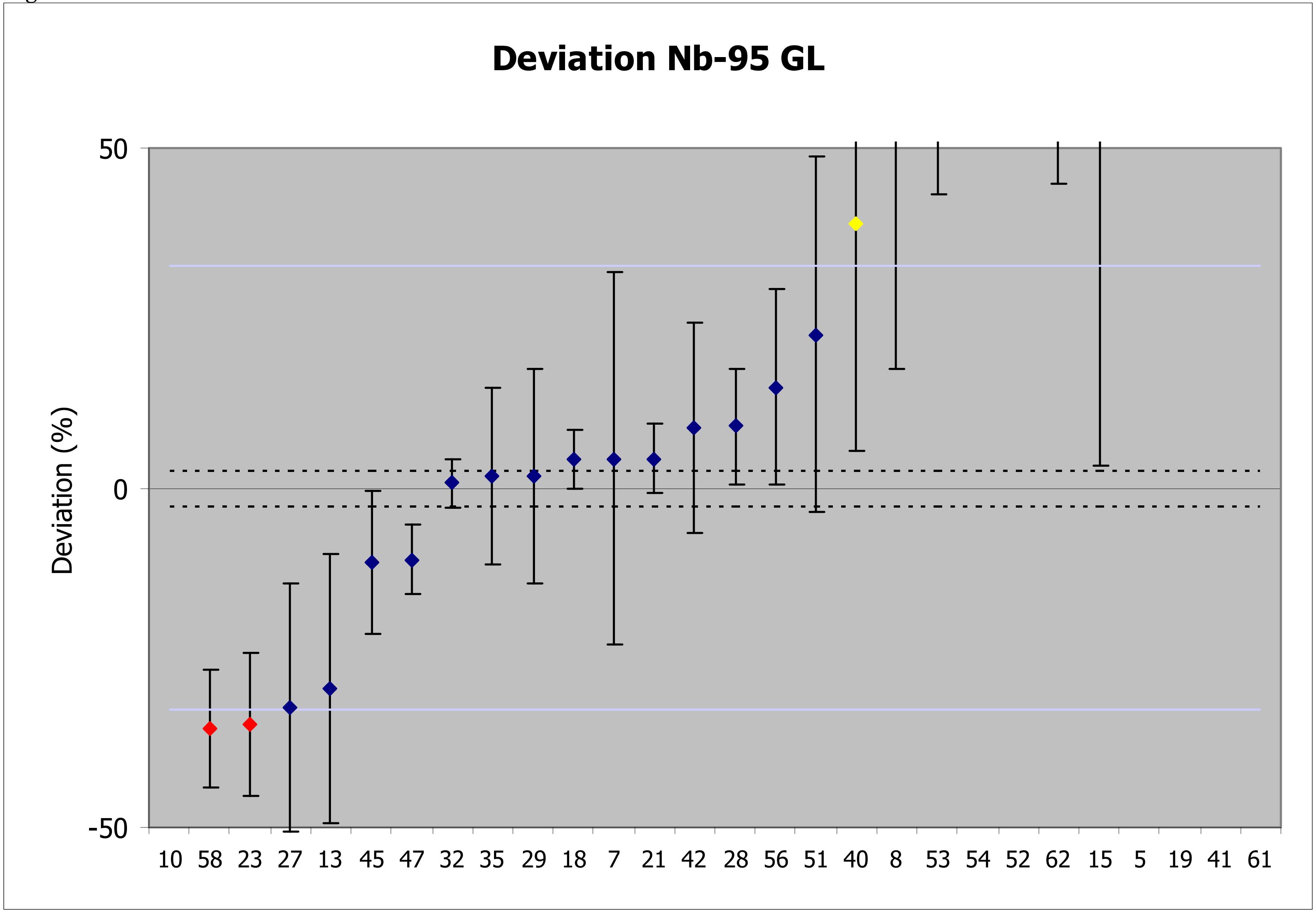


Figure 19B – Zeta score Nb-95 GL

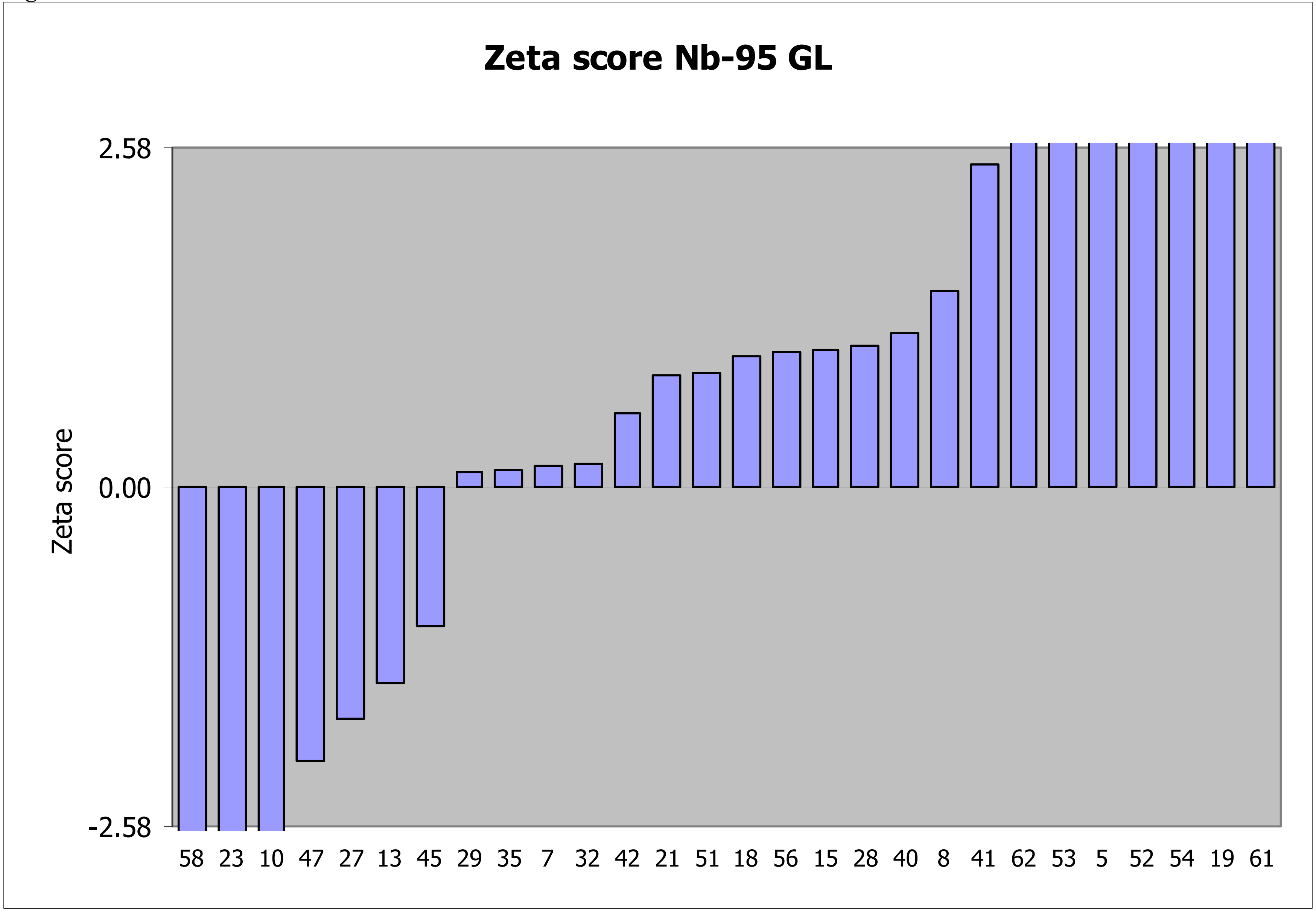


Figure 19C – Relative uncertainty Nb-95 GL

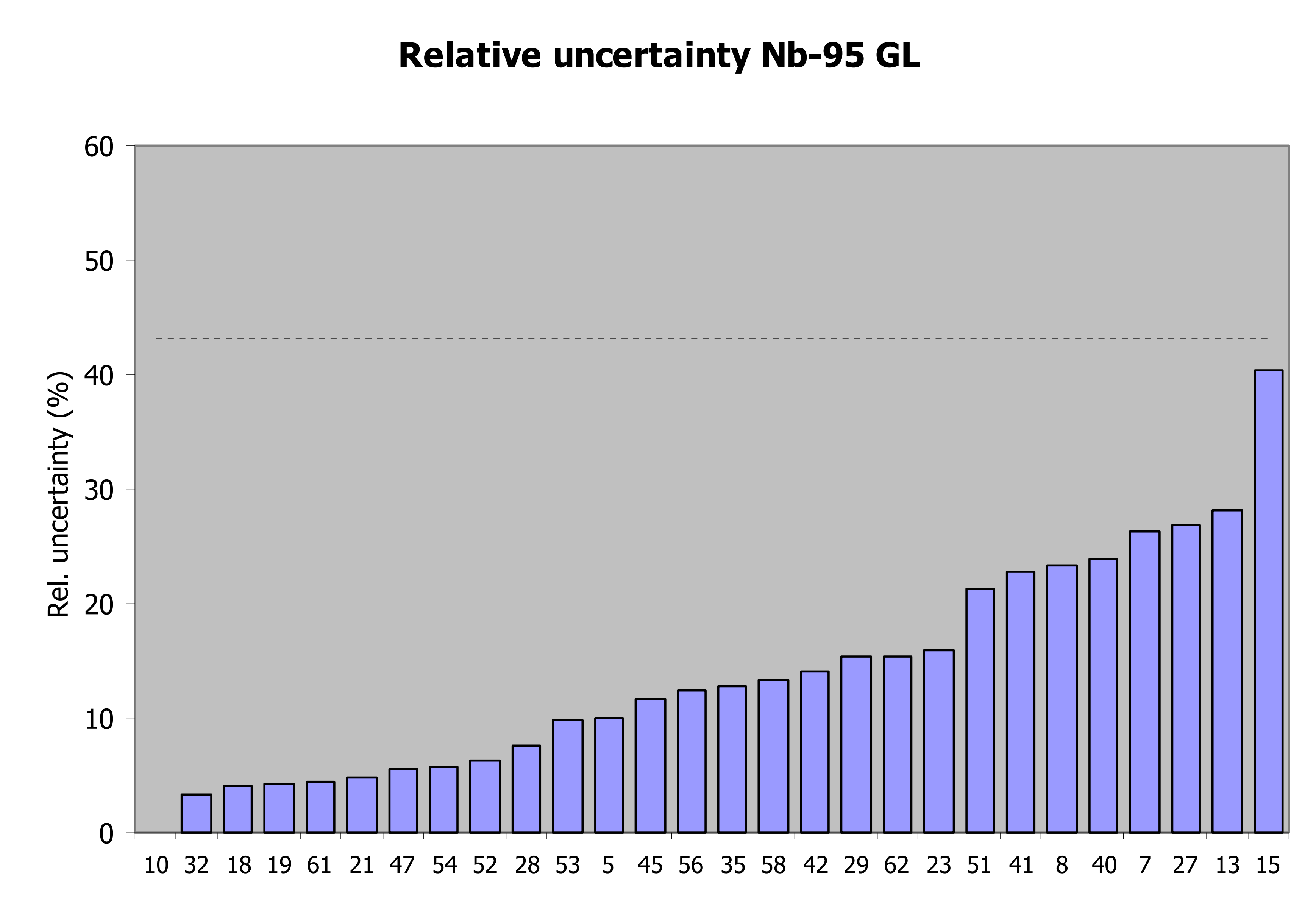


Figure 19D – Kiri plot Nb-95 GL

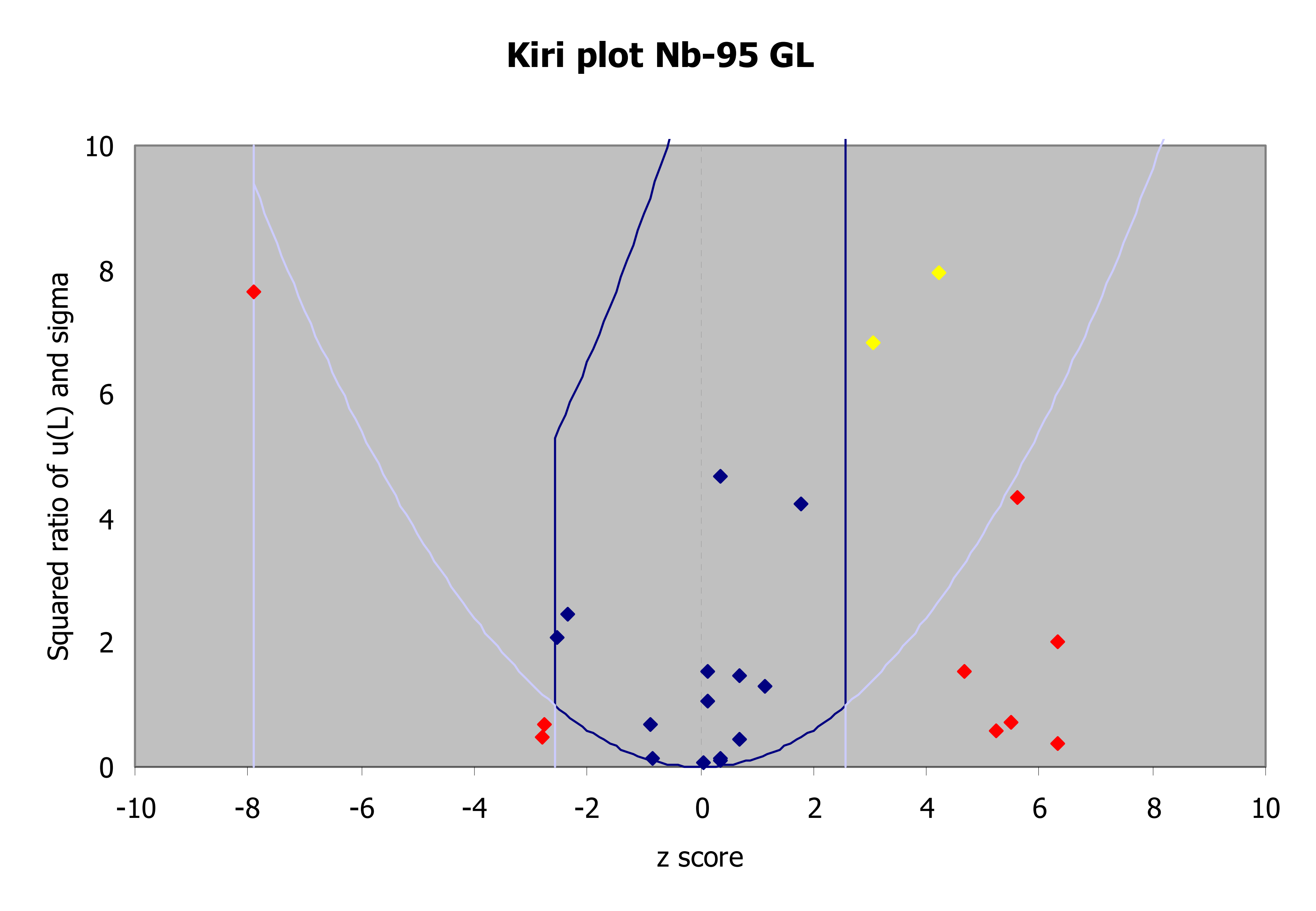


Figure 20A – Deviation Sb-125 GL

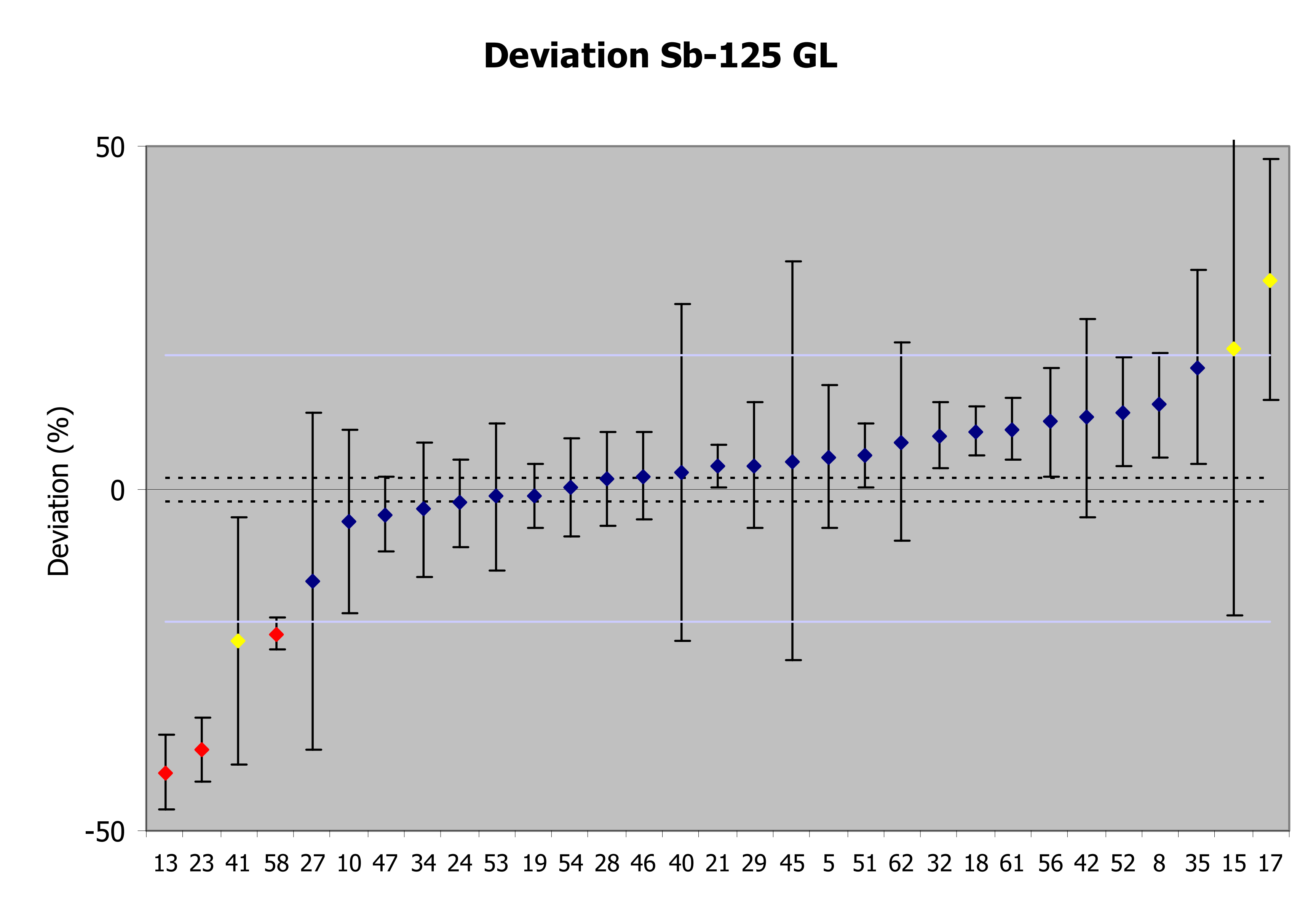


Figure 20B – Zeta score Sb-125 GL

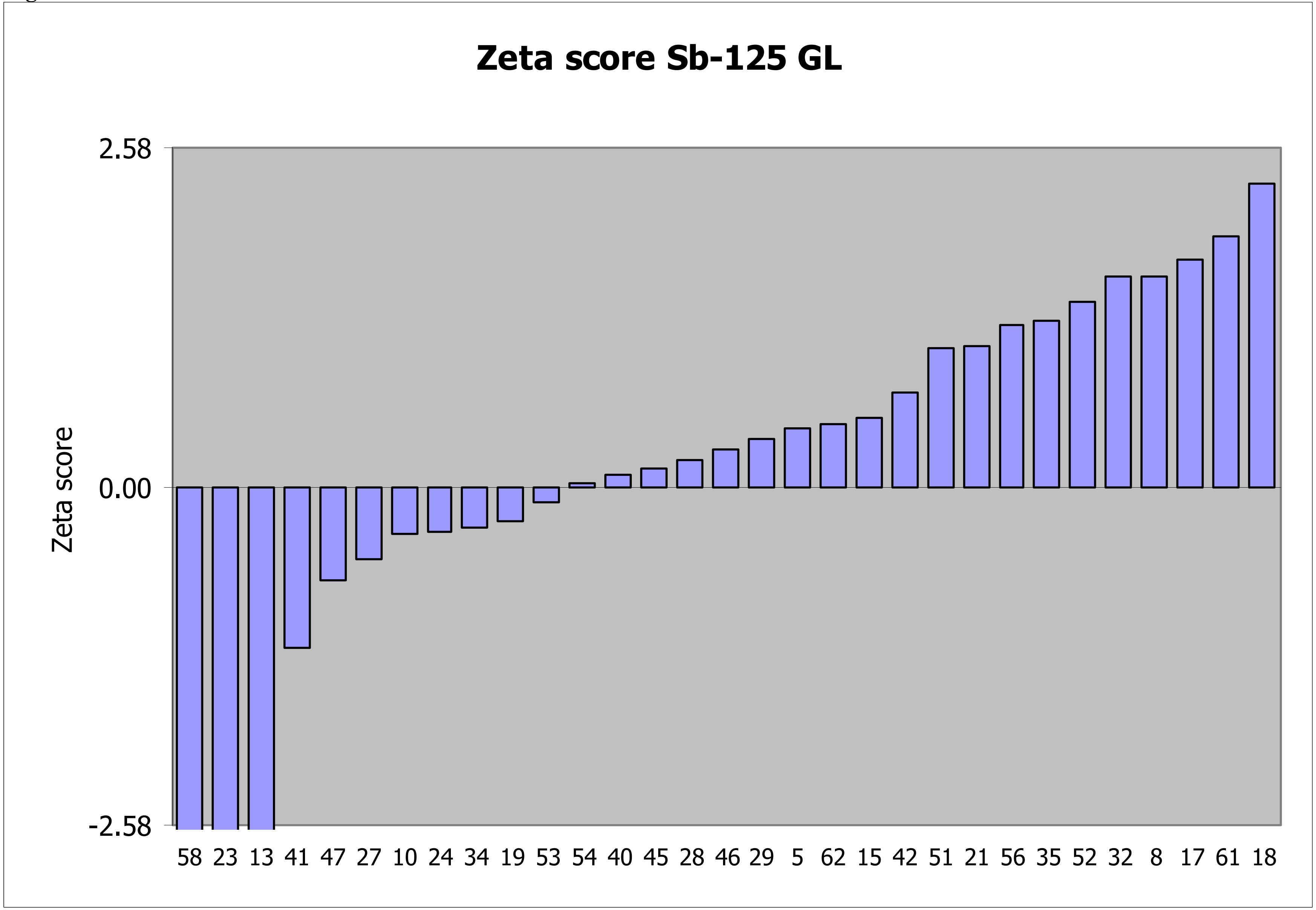


Figure 20C – Relative uncertainty Sb-125 GL

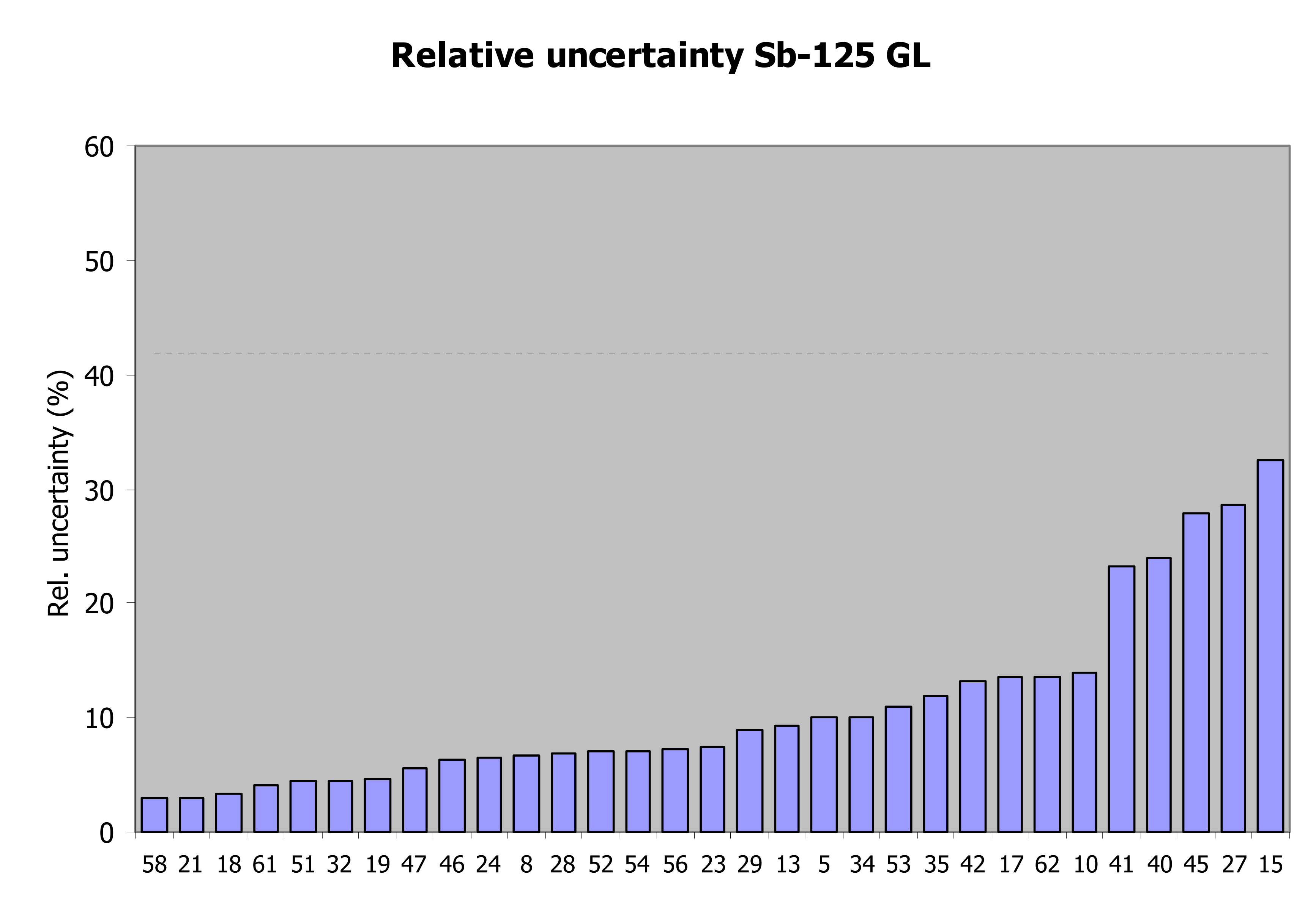


Figure 20D – Kiri plot Sb-125 GL

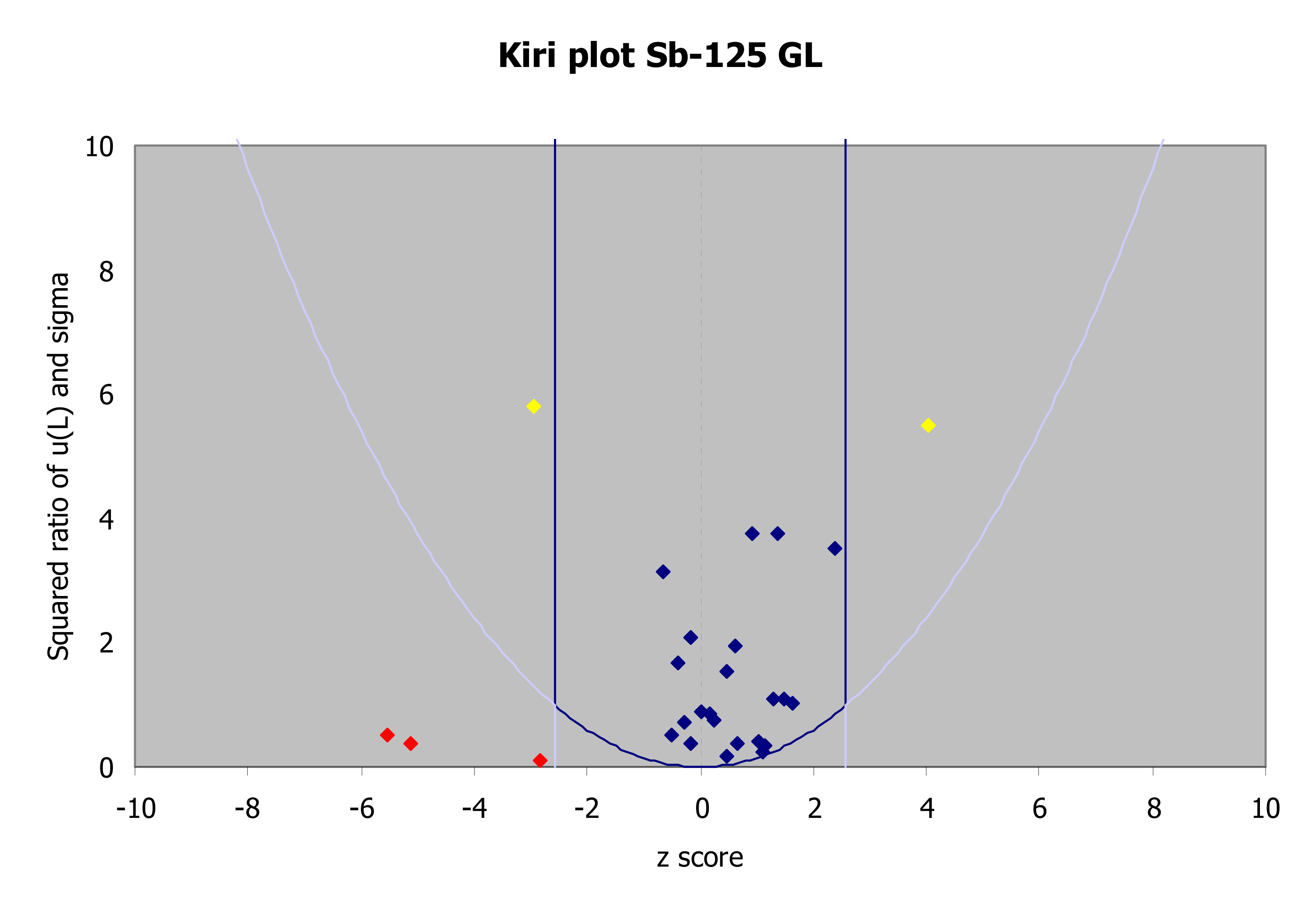


Figure 21A – Deviation Ba-133 GL

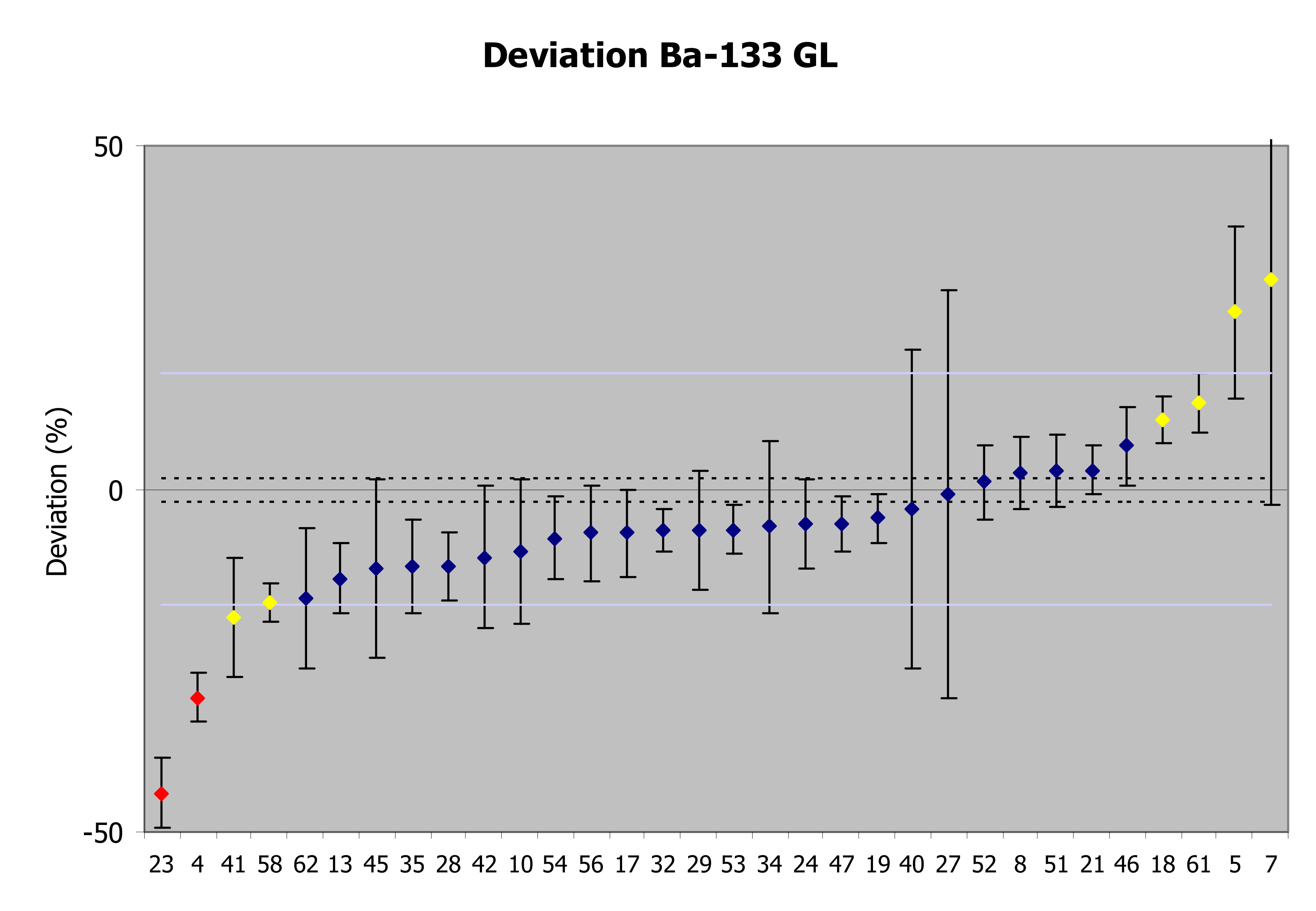


Figure 21B – Zeta score Ba-133 GL

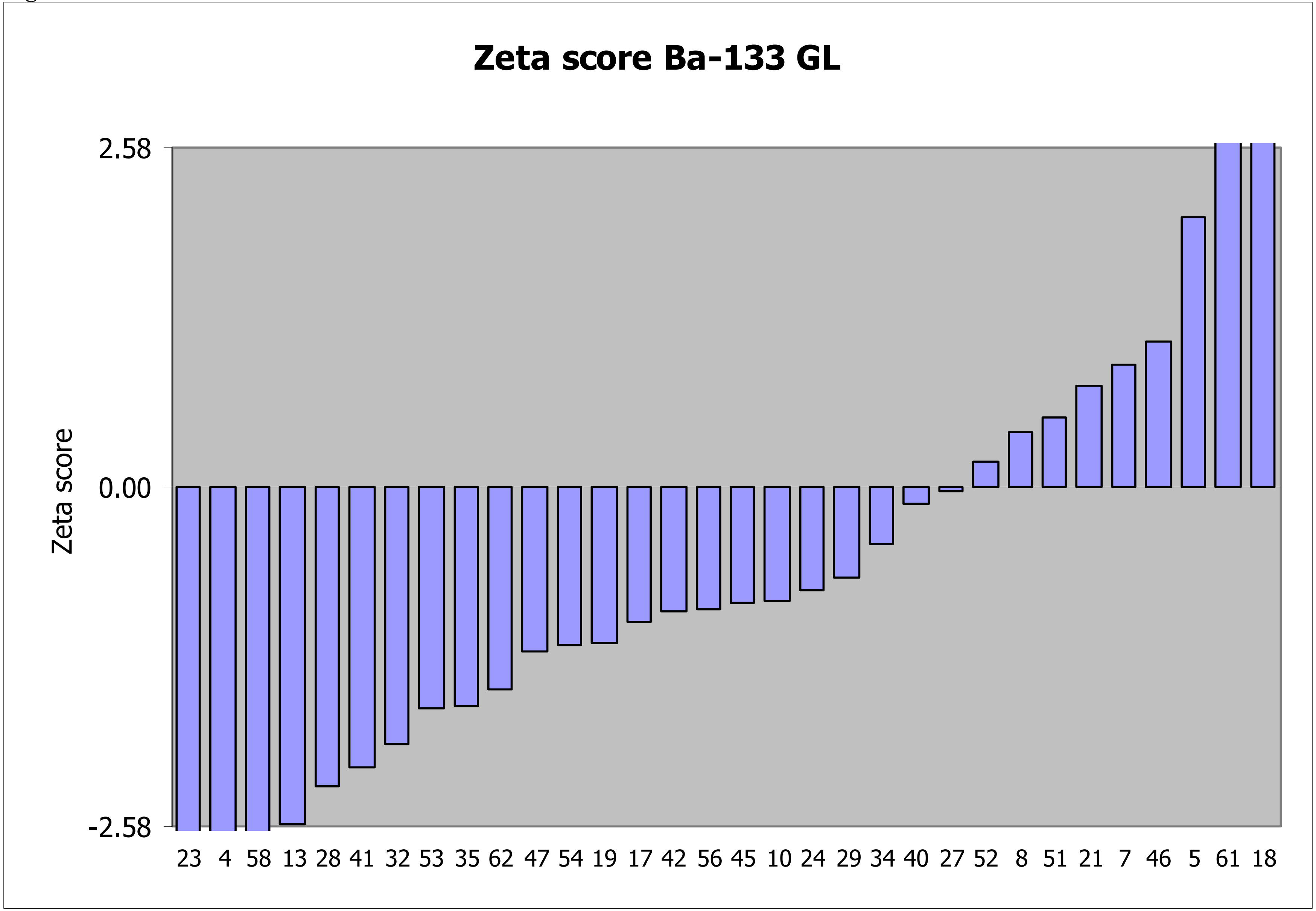


Figure 21C – Relative uncertainty Ba-133 GL

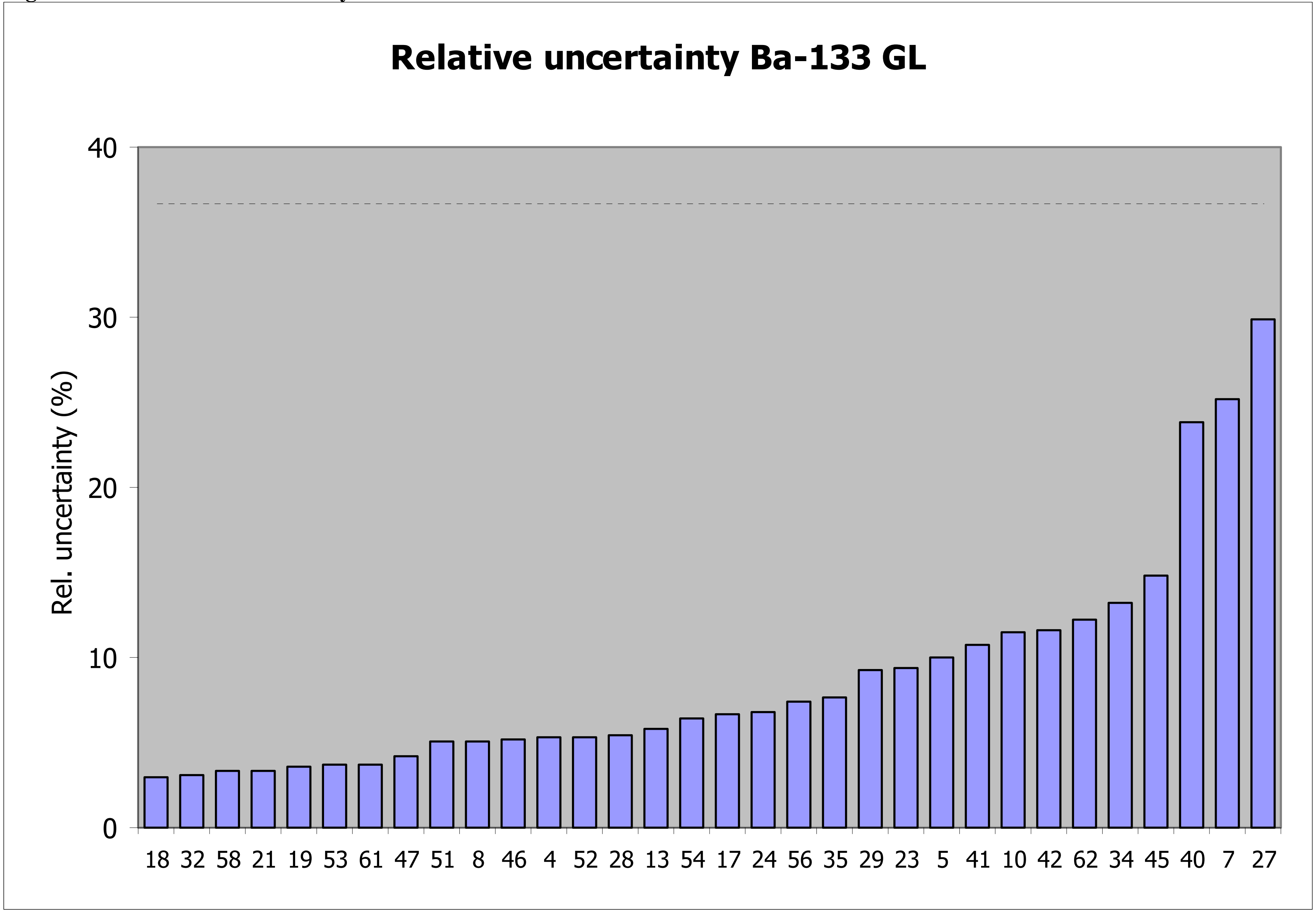


Figure 21D – Kiri plot Ba-133 GL

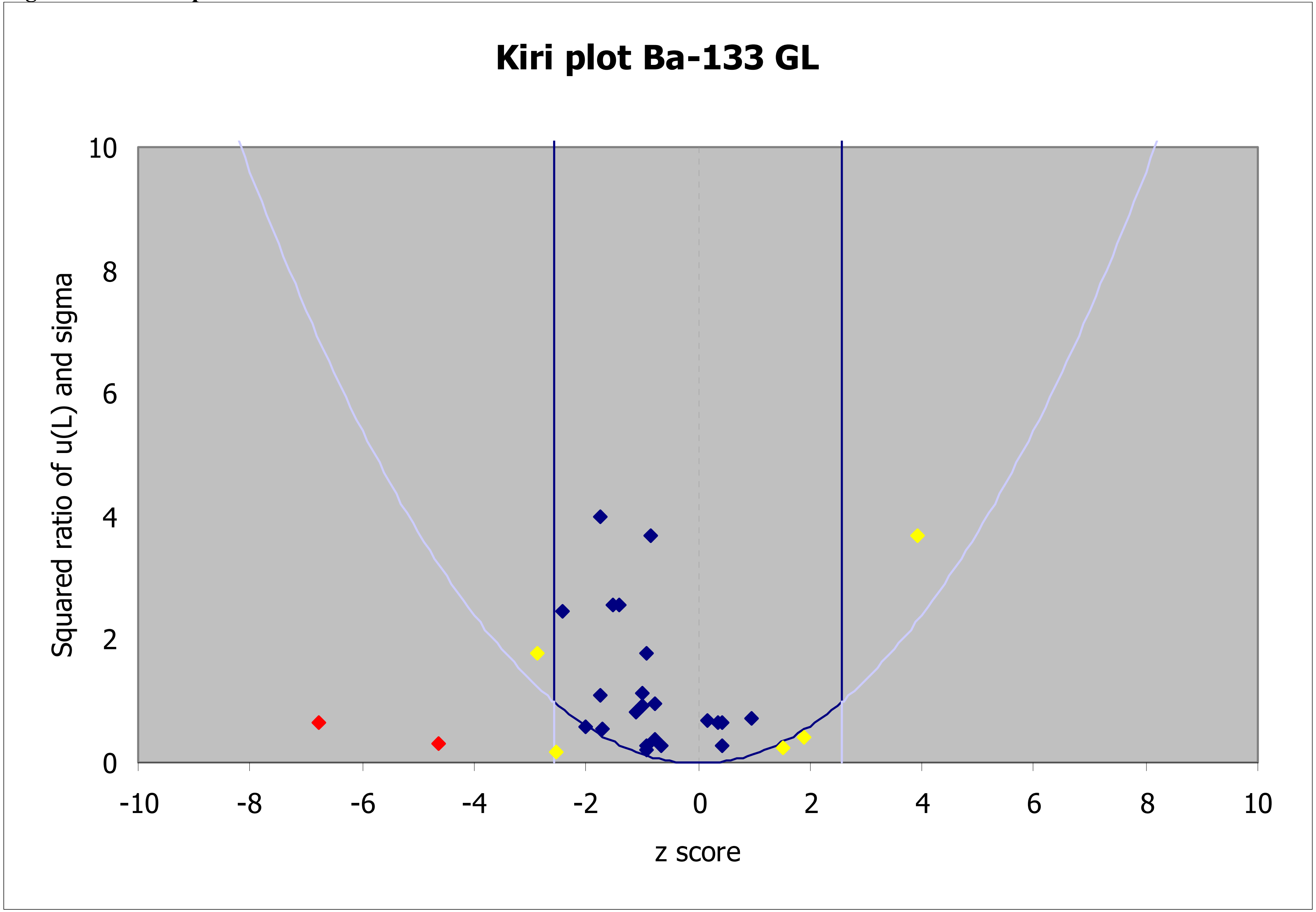


Figure 22A – Deviation Cs-134 GL

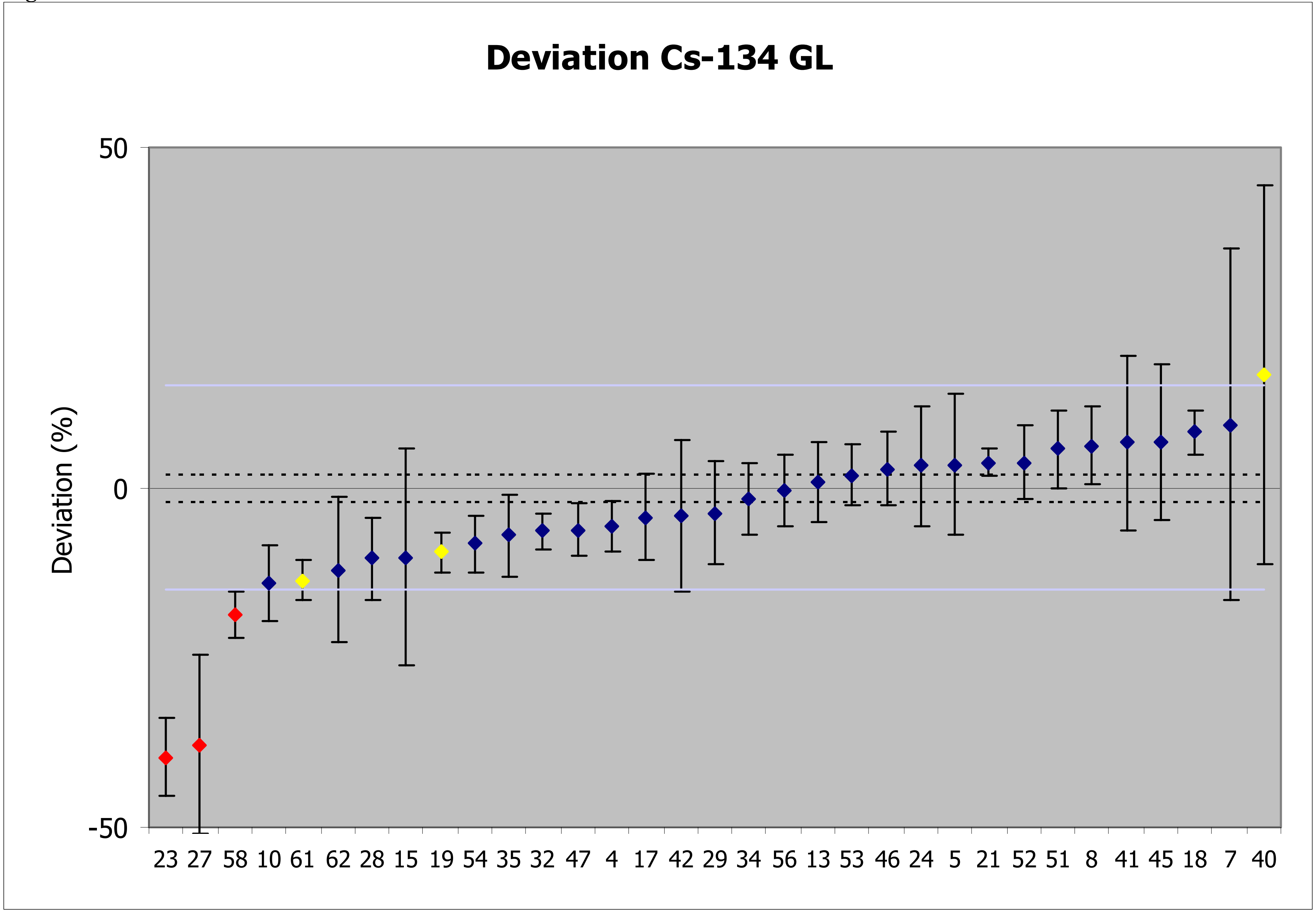


Figure 22B – Zeta score Cs-134 GL

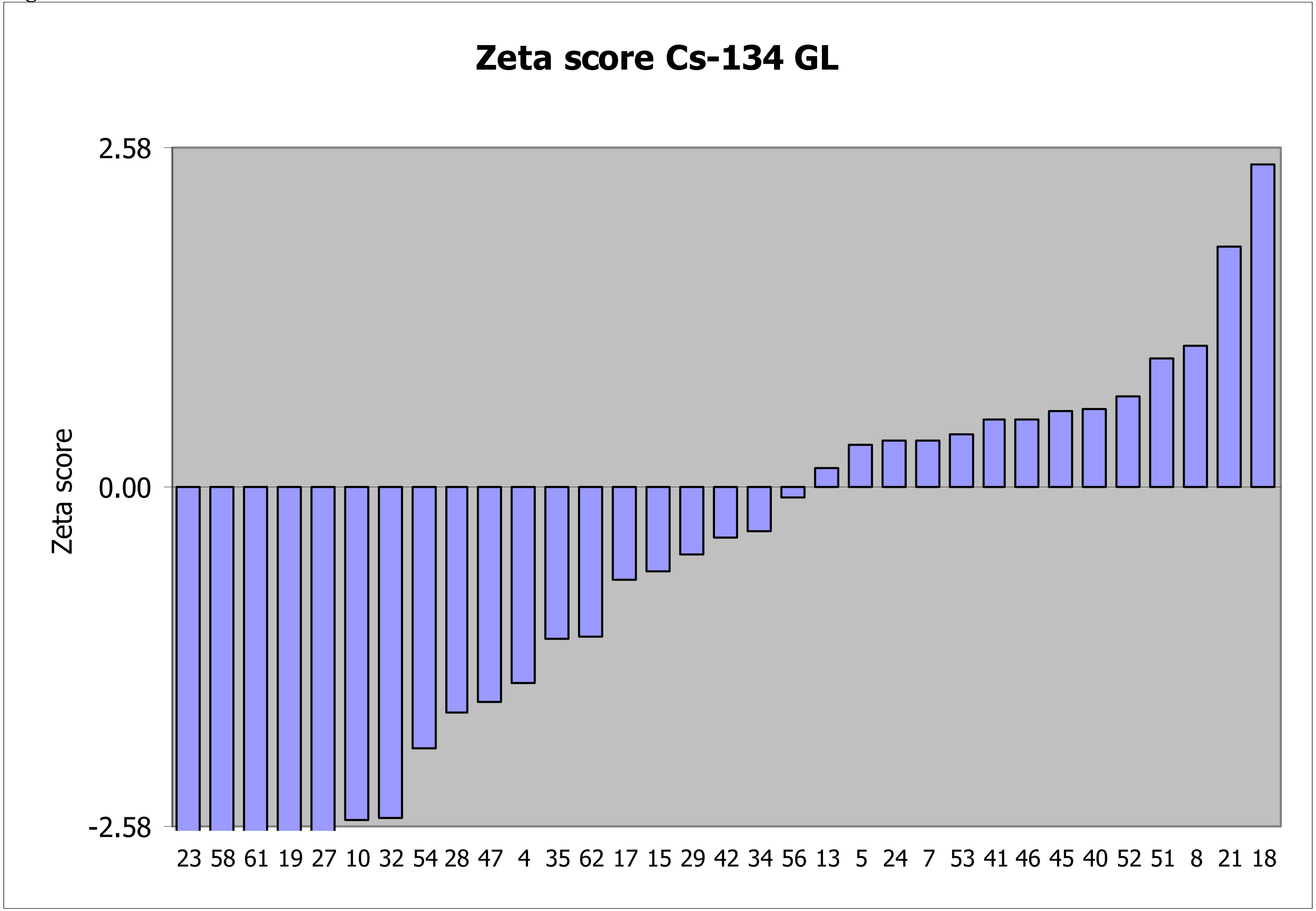


Figure 22C – Relative uncertainty Cs-134 GL

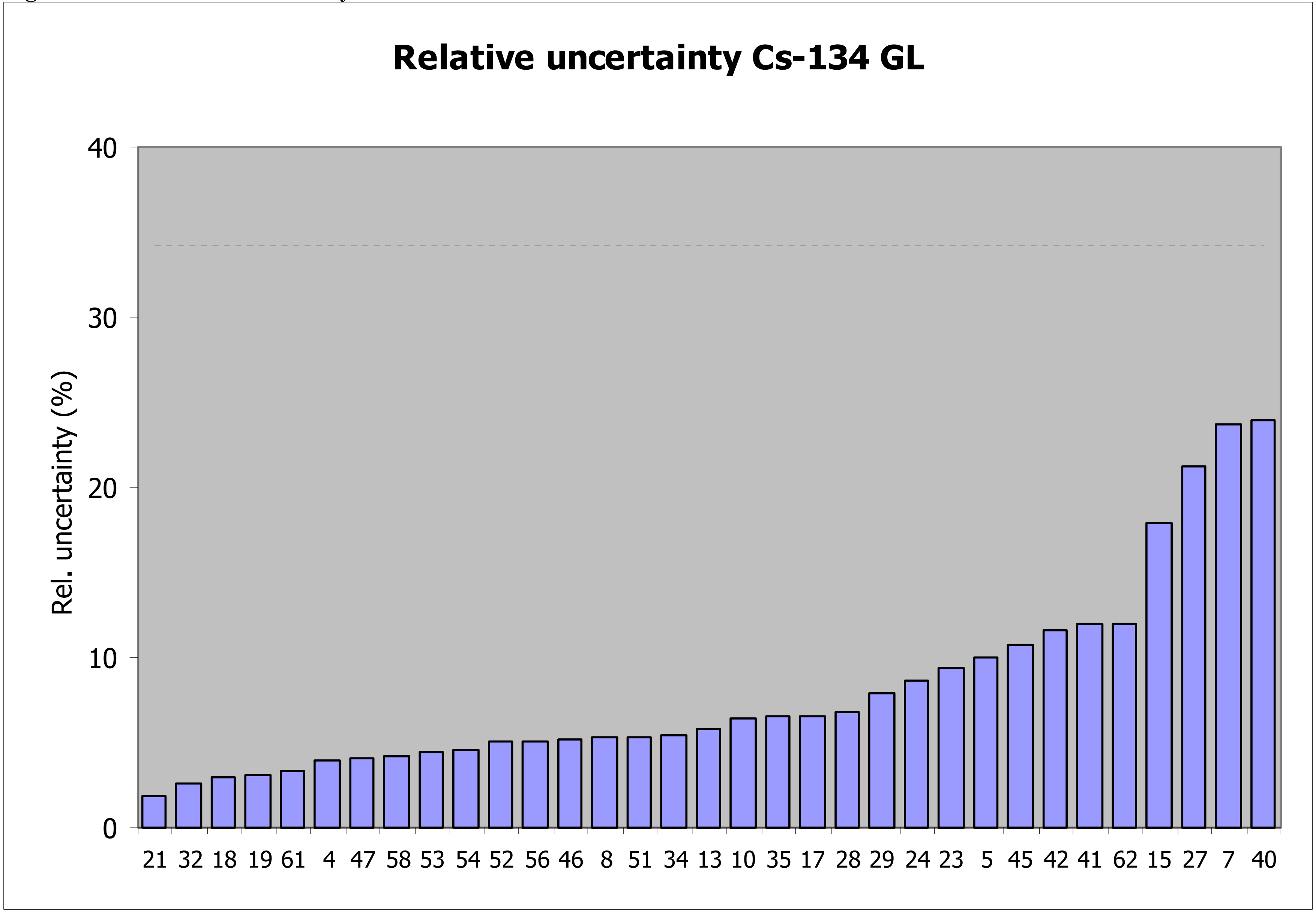


Figure 22D – Kiri plot Cs-134 GL

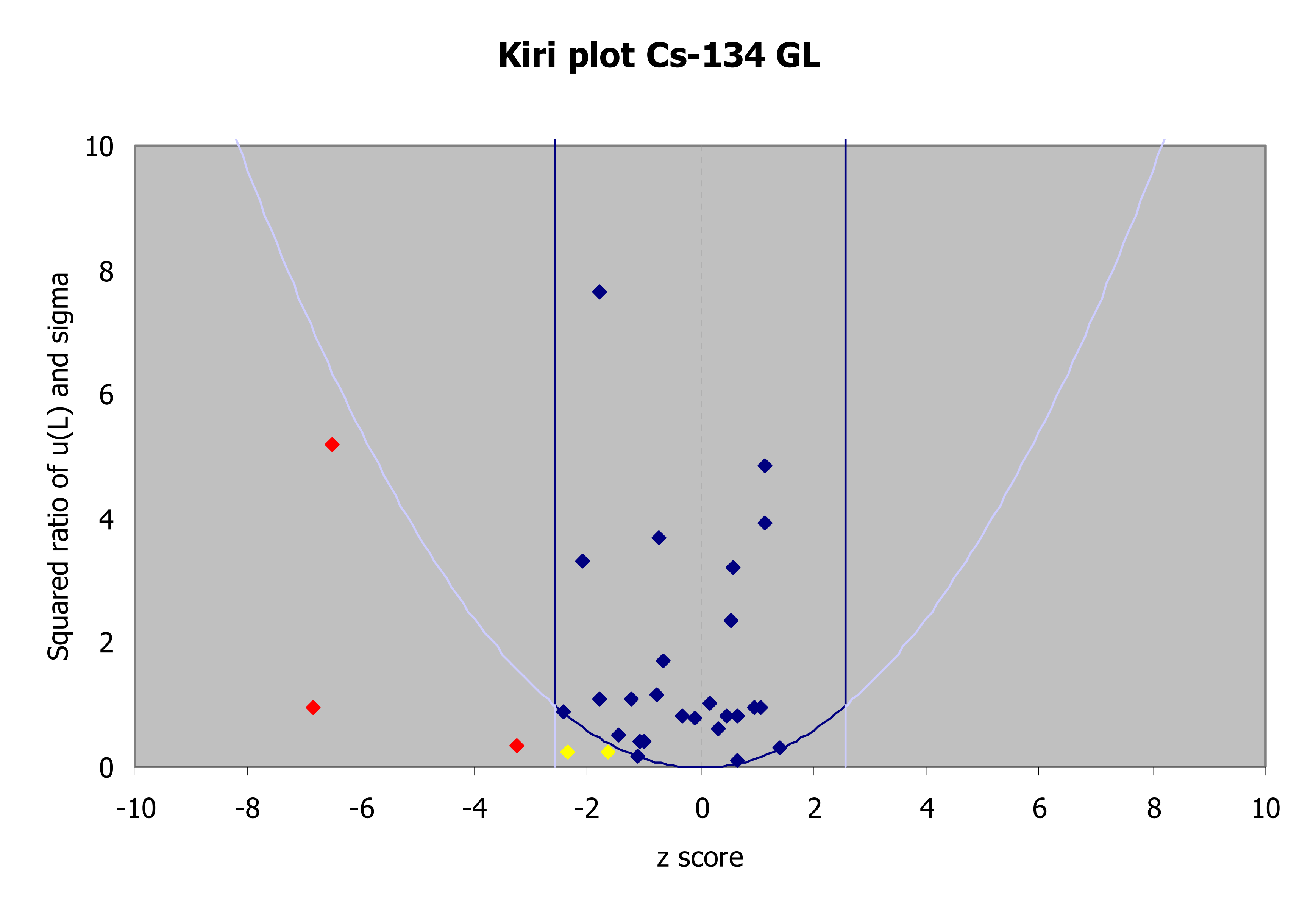


Figure 23A – Deviation Cs-137 GL

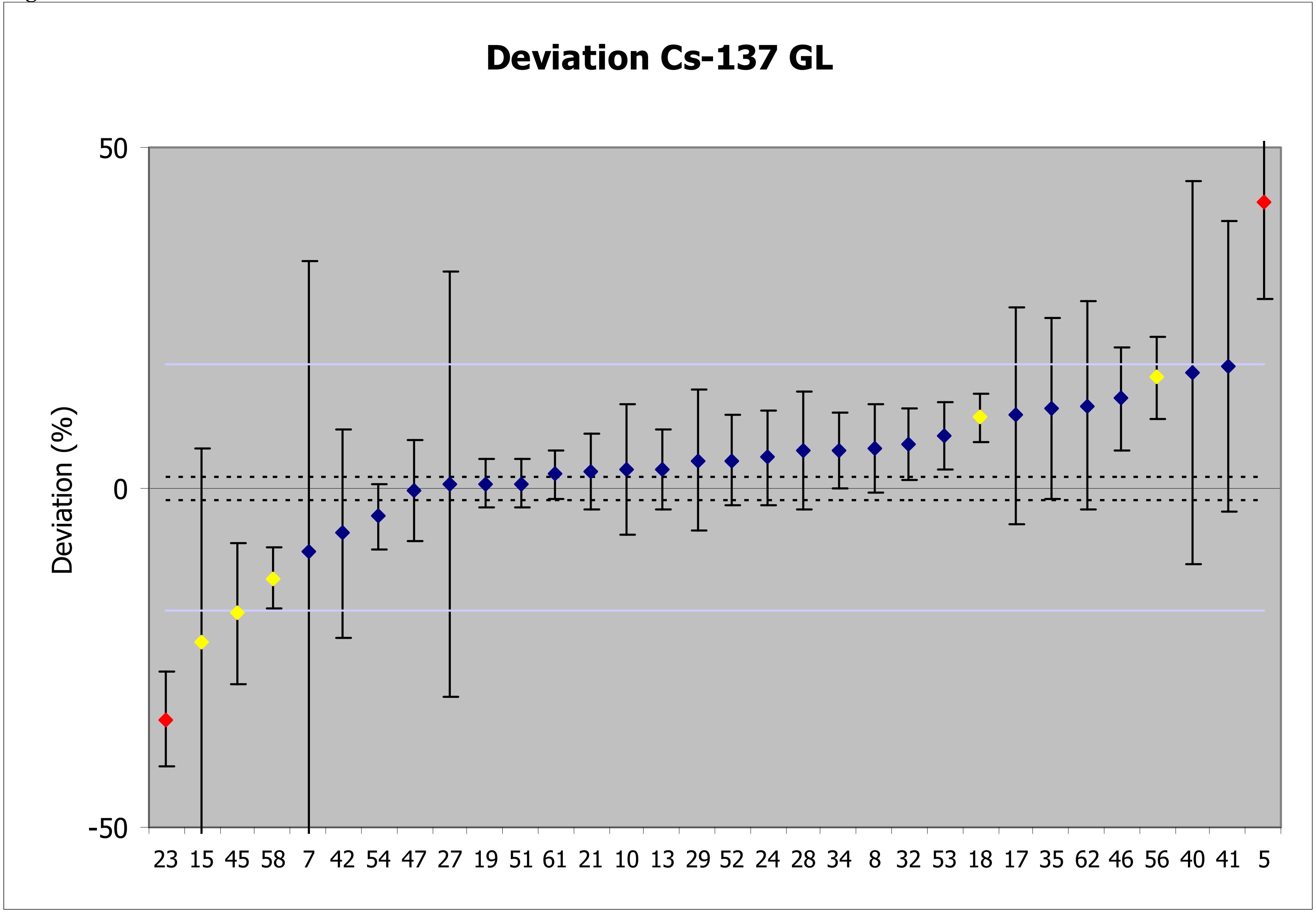


Figure 23B – Zeta score Cs-137 GL

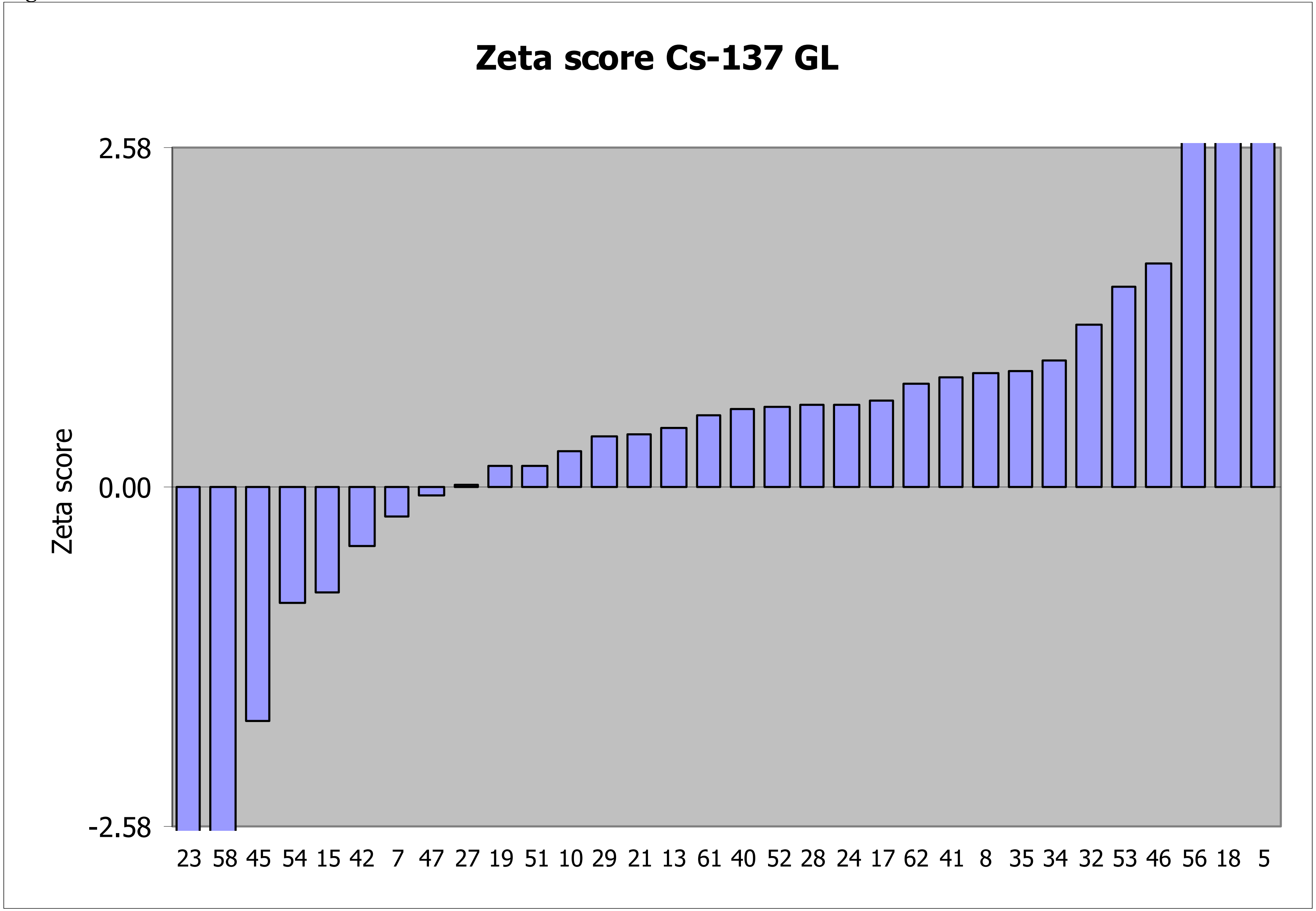


Figure 23C – Relative uncertainty Cs-137 GL

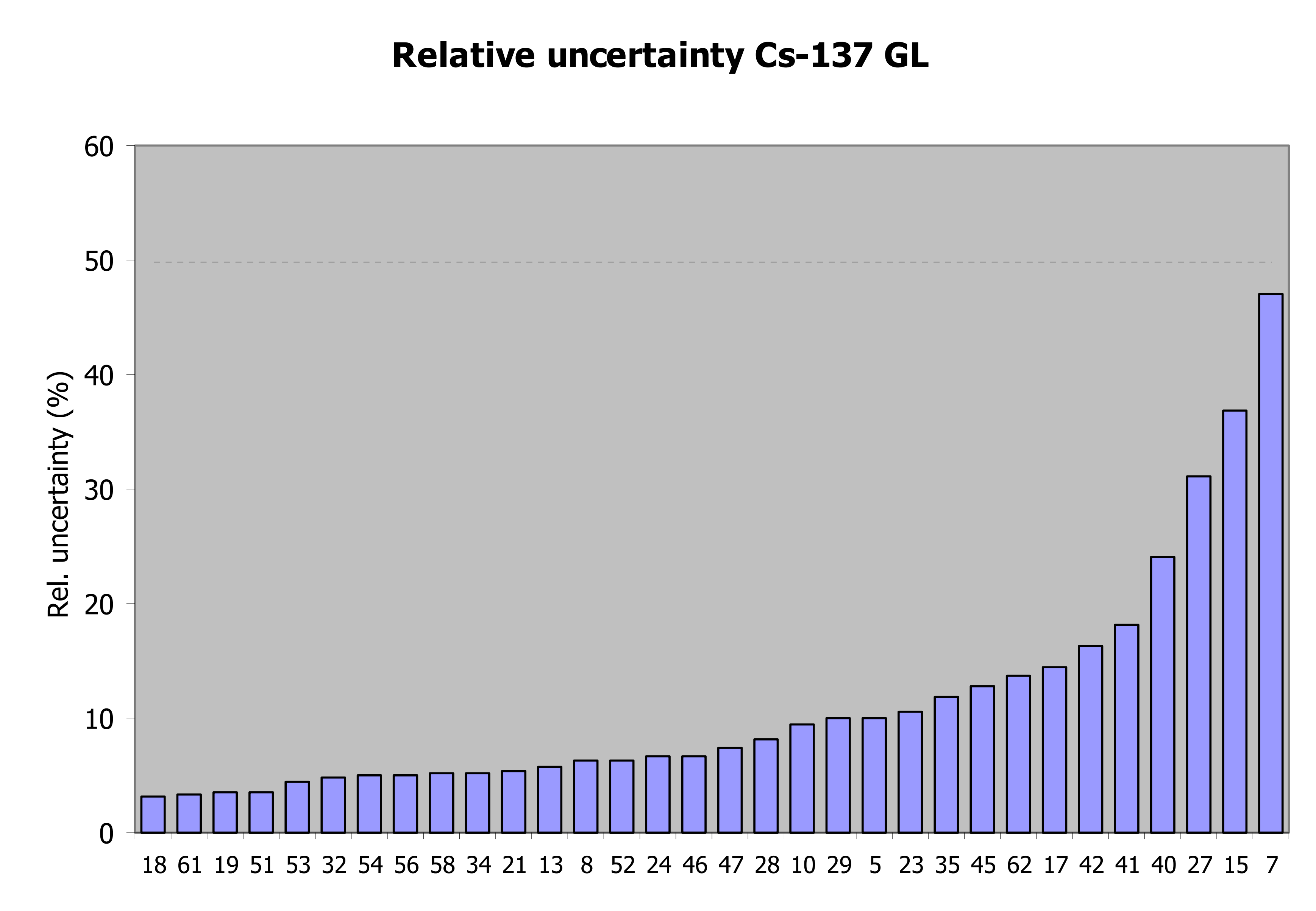


Figure 23D – Kiri plot Cs-137 GL

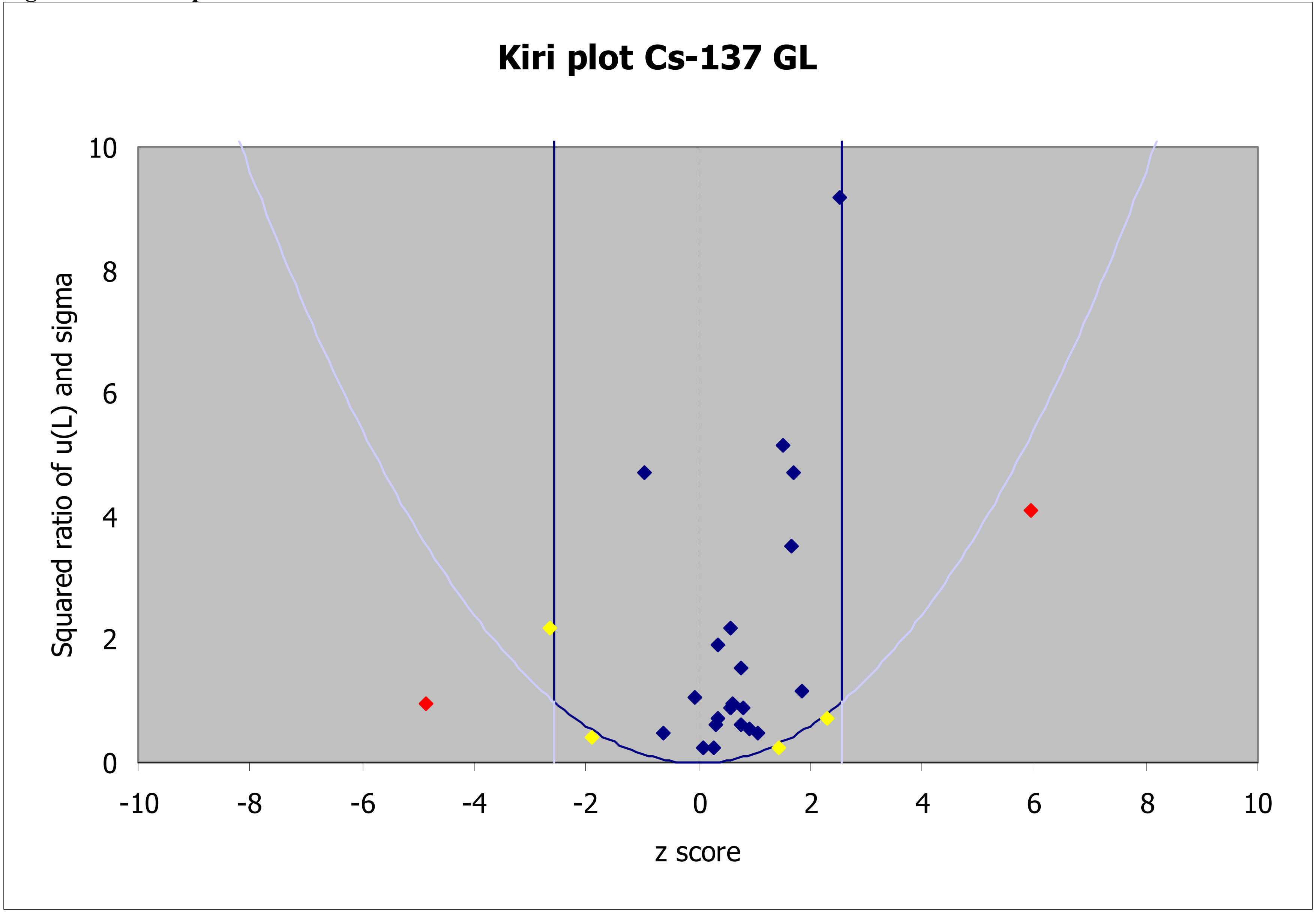


Figure 24A – Deviation Eu-152 GL

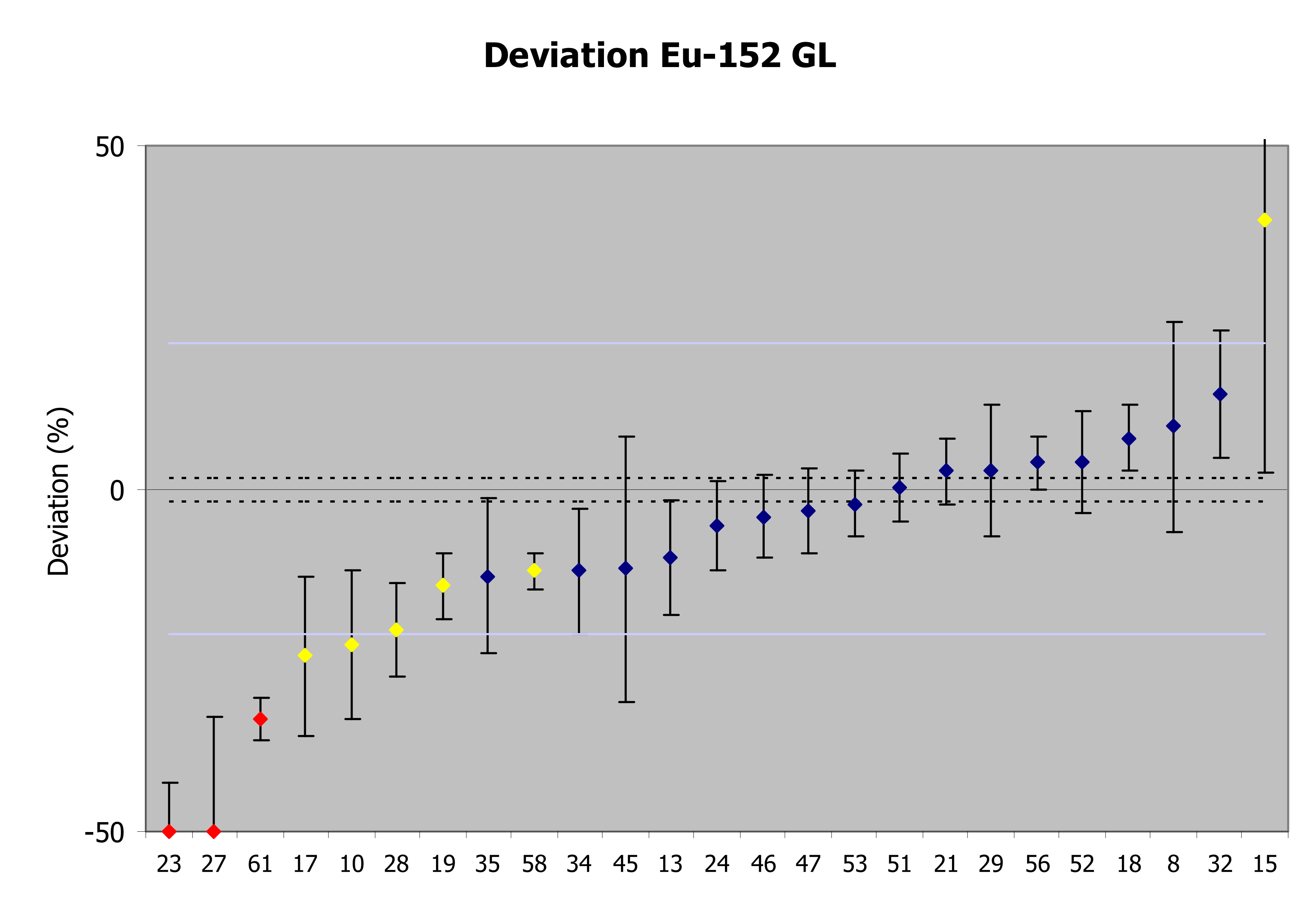


Figure 24B – Zeta score Eu-152 GL

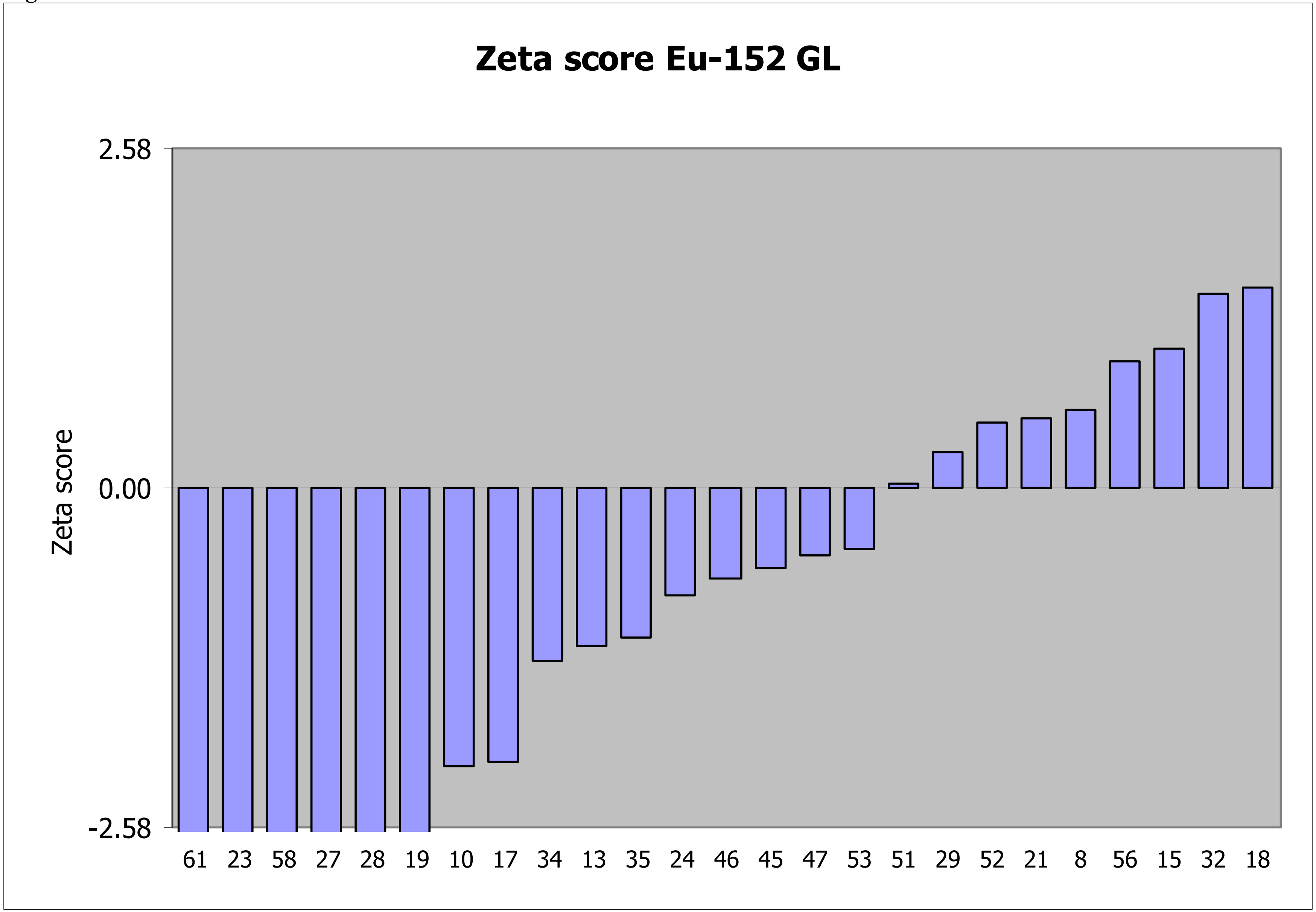


Figure 24C – Relative uncertainty Eu-152 GL

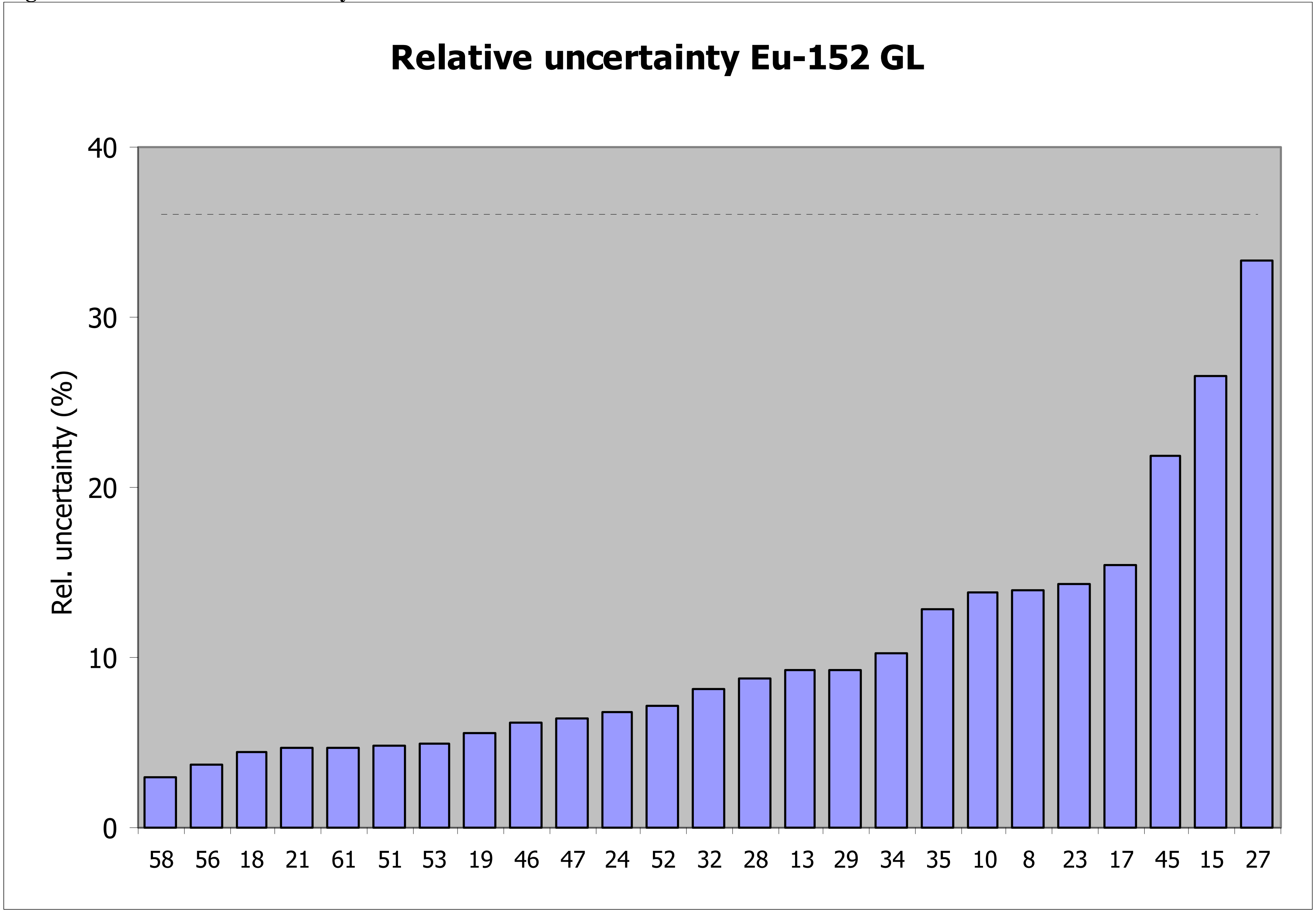


Figure 24D – Kiri plot Eu-152 GL

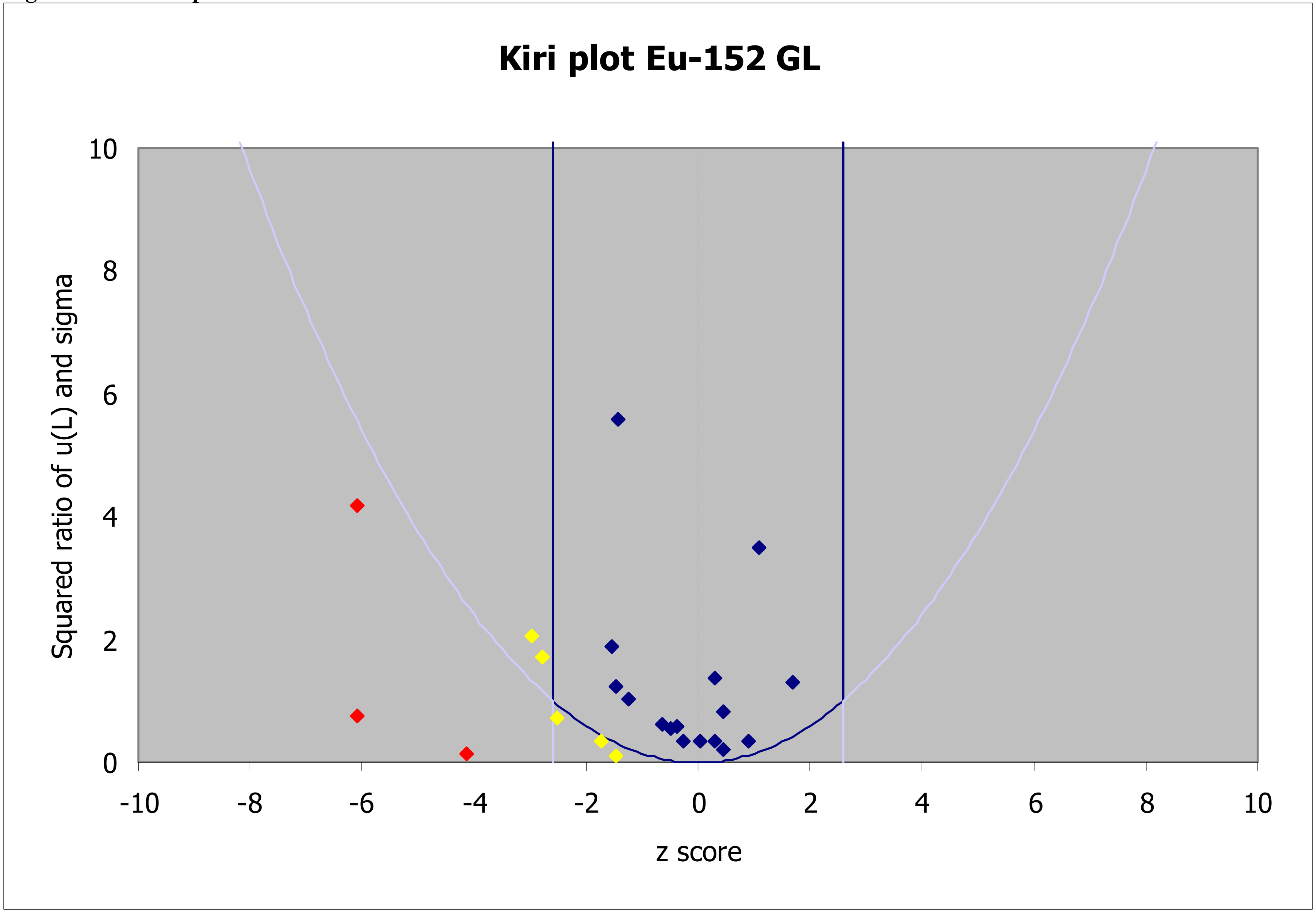


Figure 25A – Deviation Na-22 GH

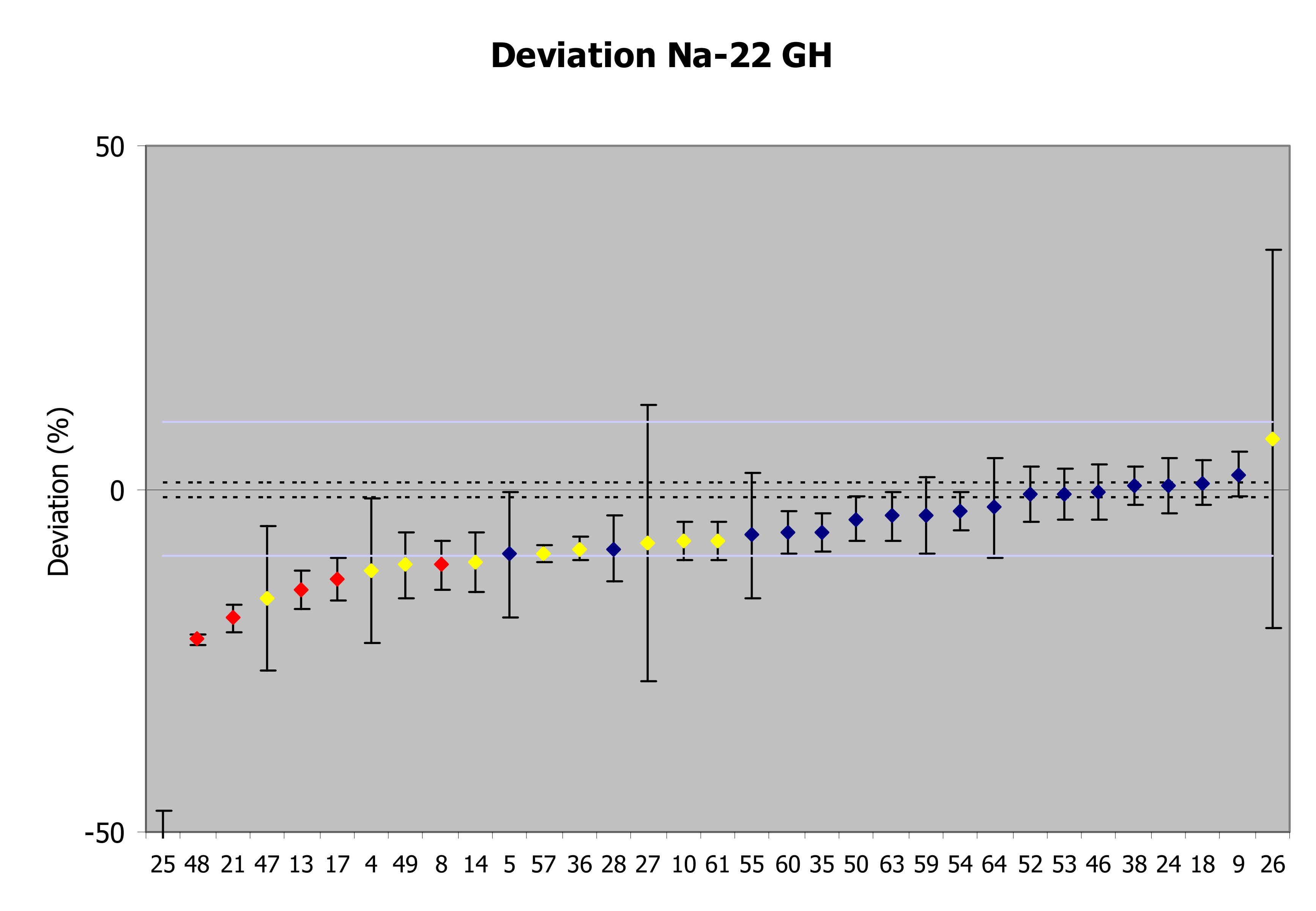


Figure 25B – Zeta score Na-22 GH

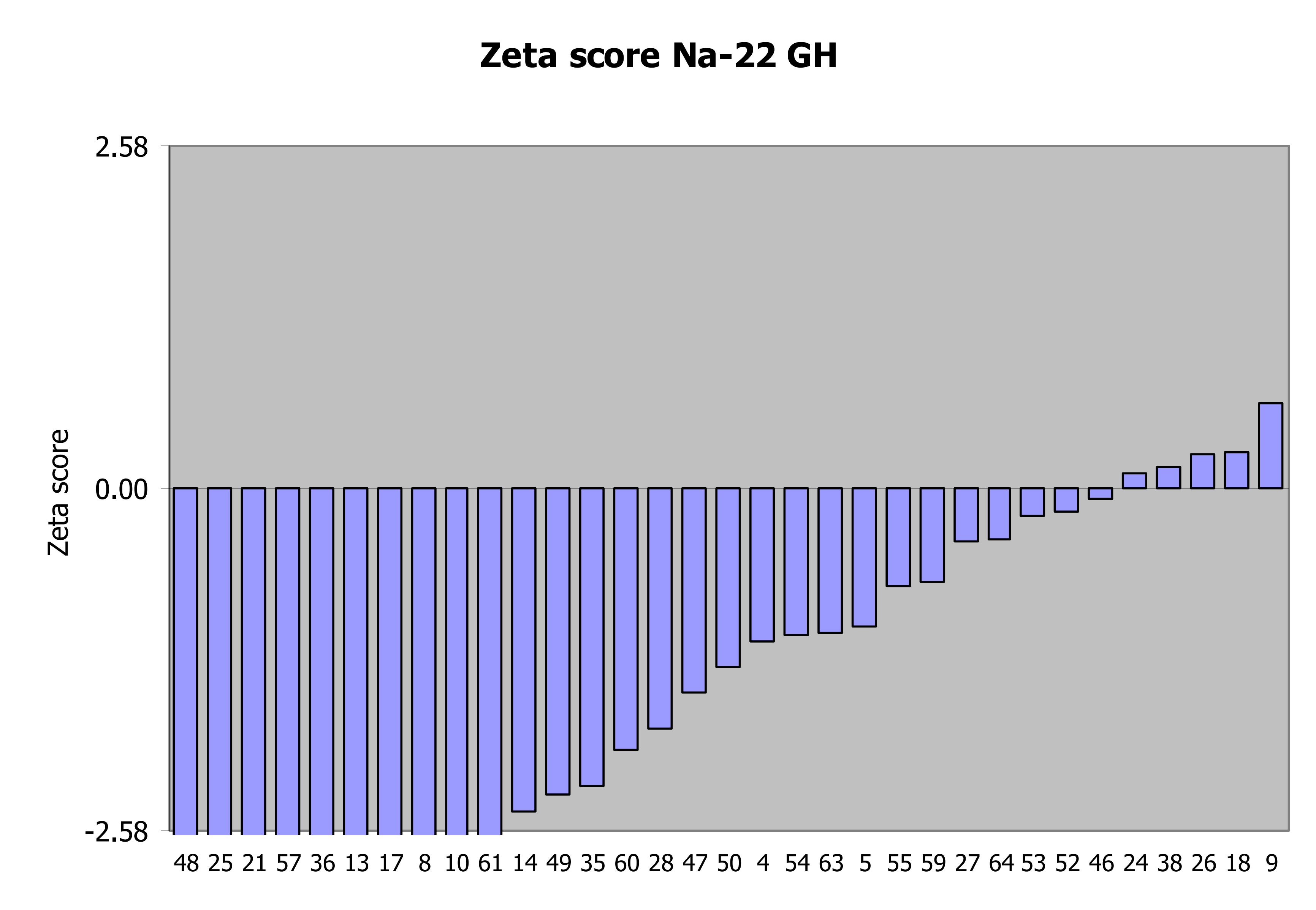


Figure 25C – Relative uncertainty Na-22 GH

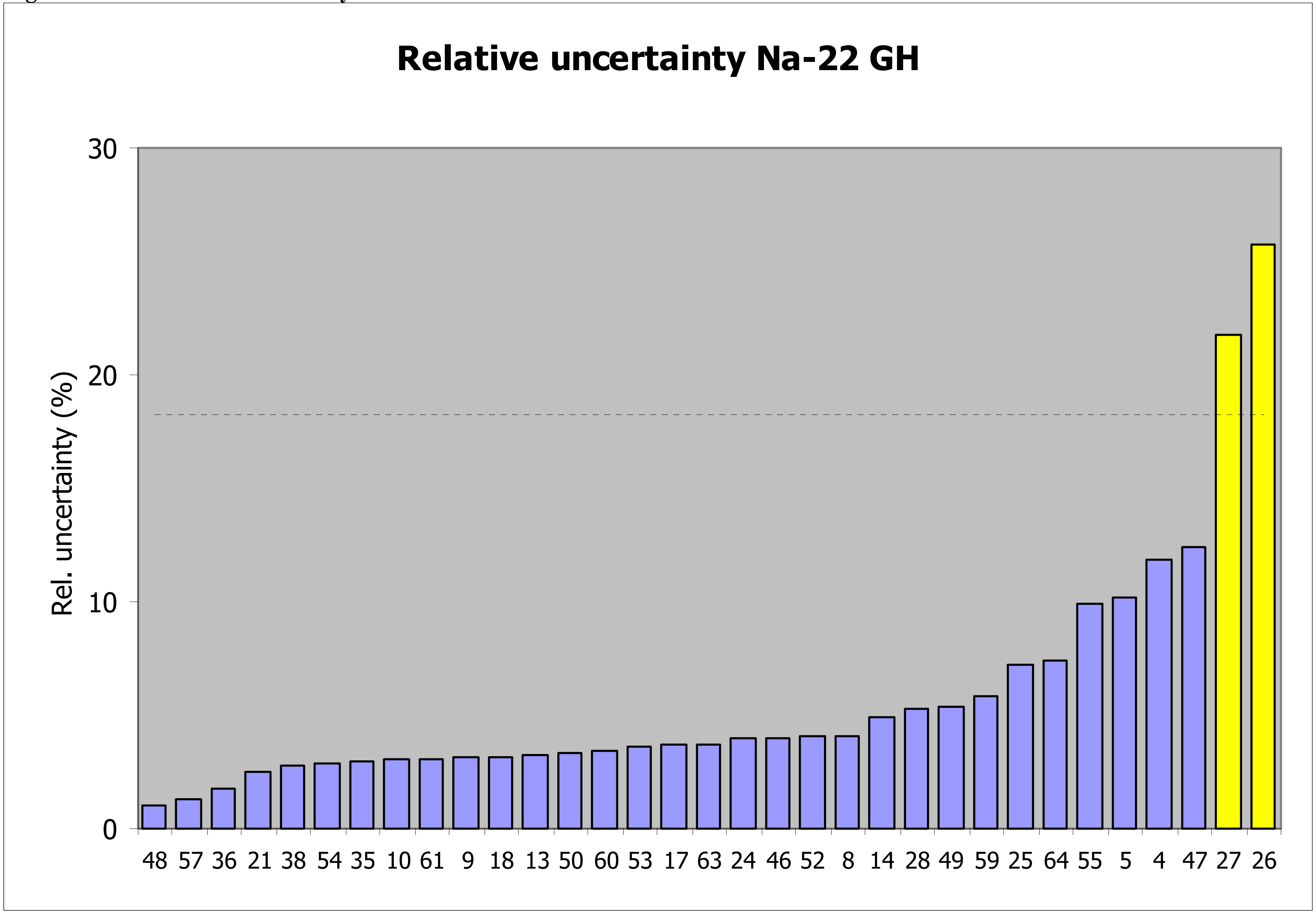


Figure 25D – Kiri plot Na-22 GH

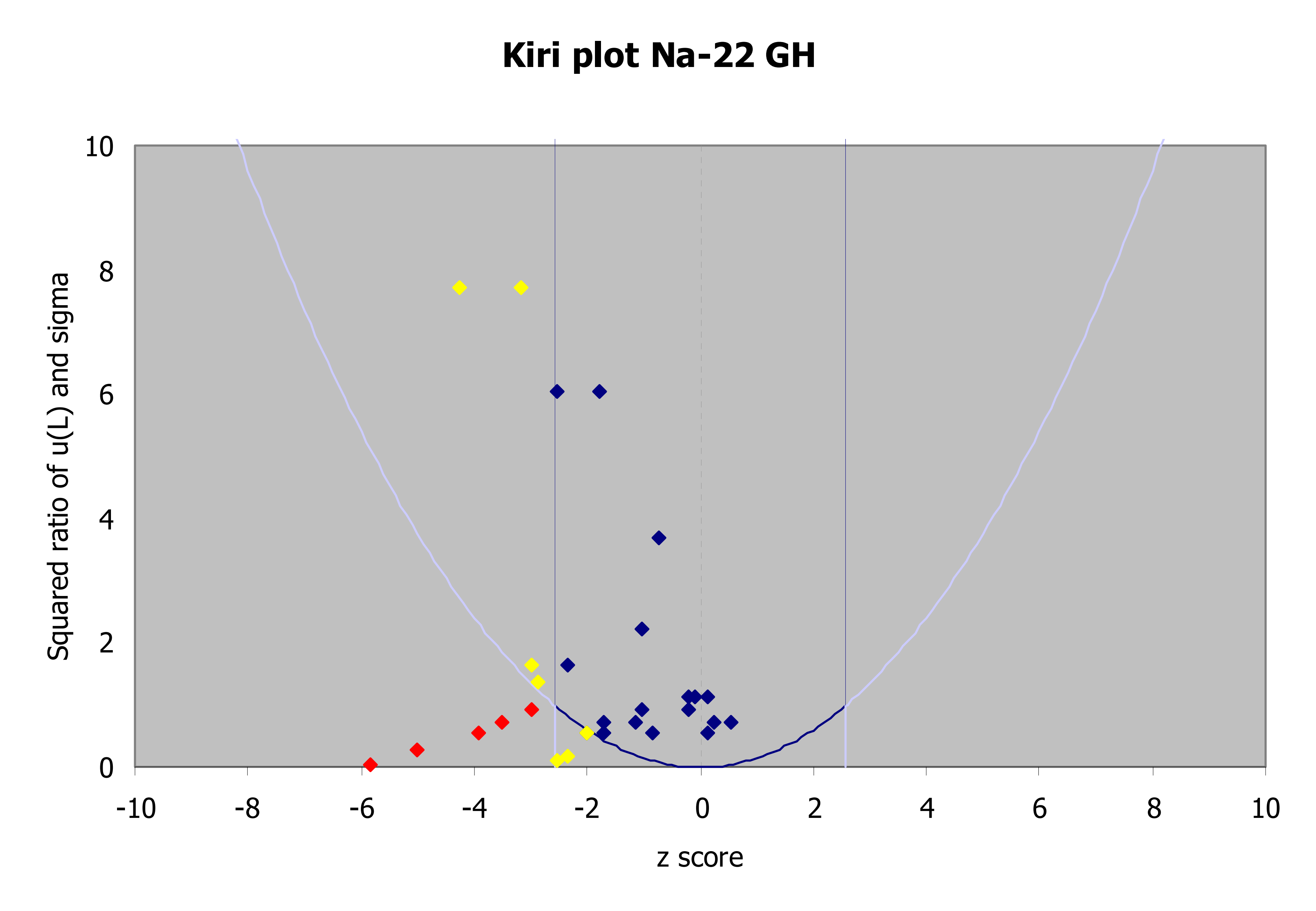


Figure 26A – Deviation Co-60 GH

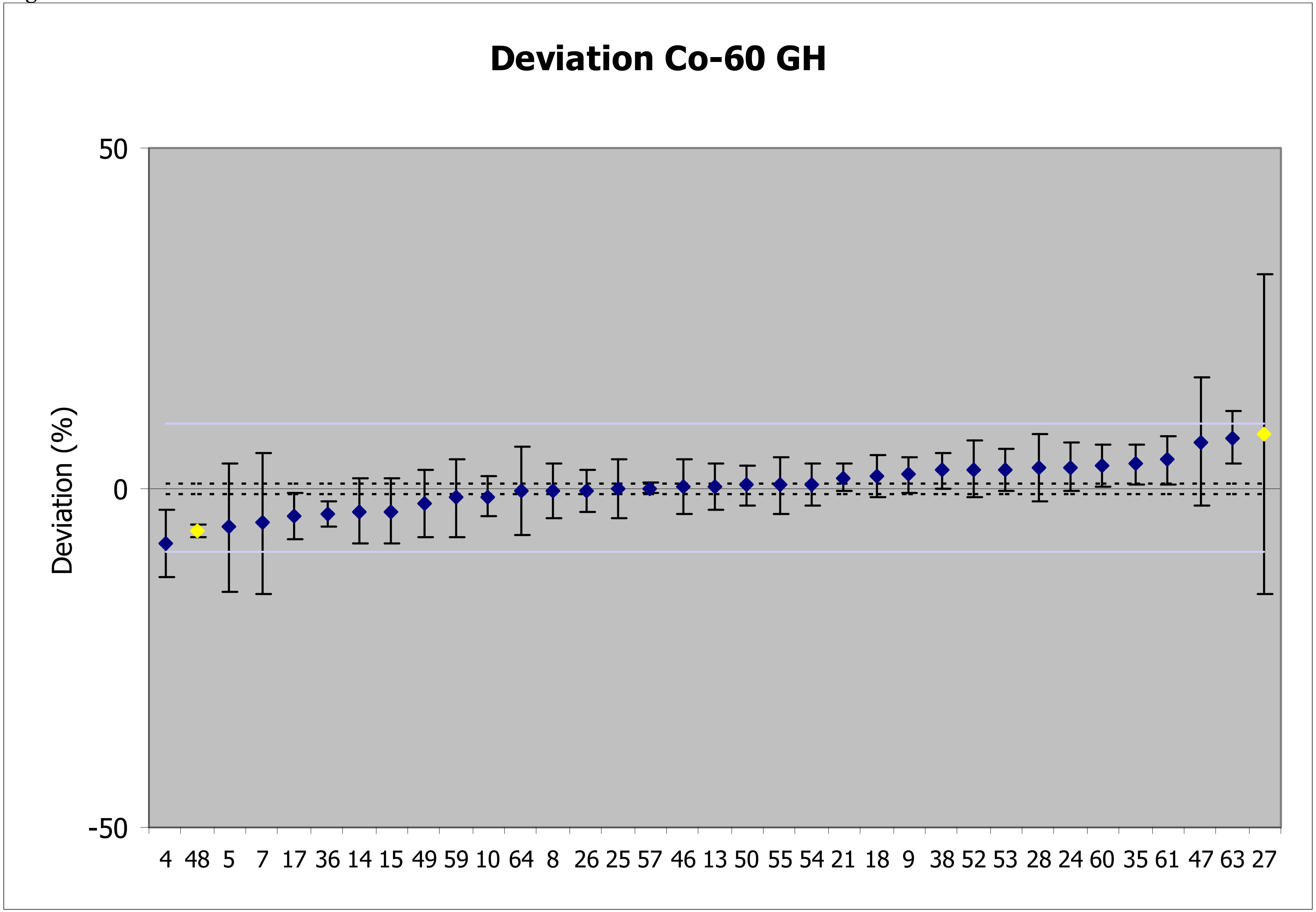


Figure 26B – Zeta score Co-60 GH

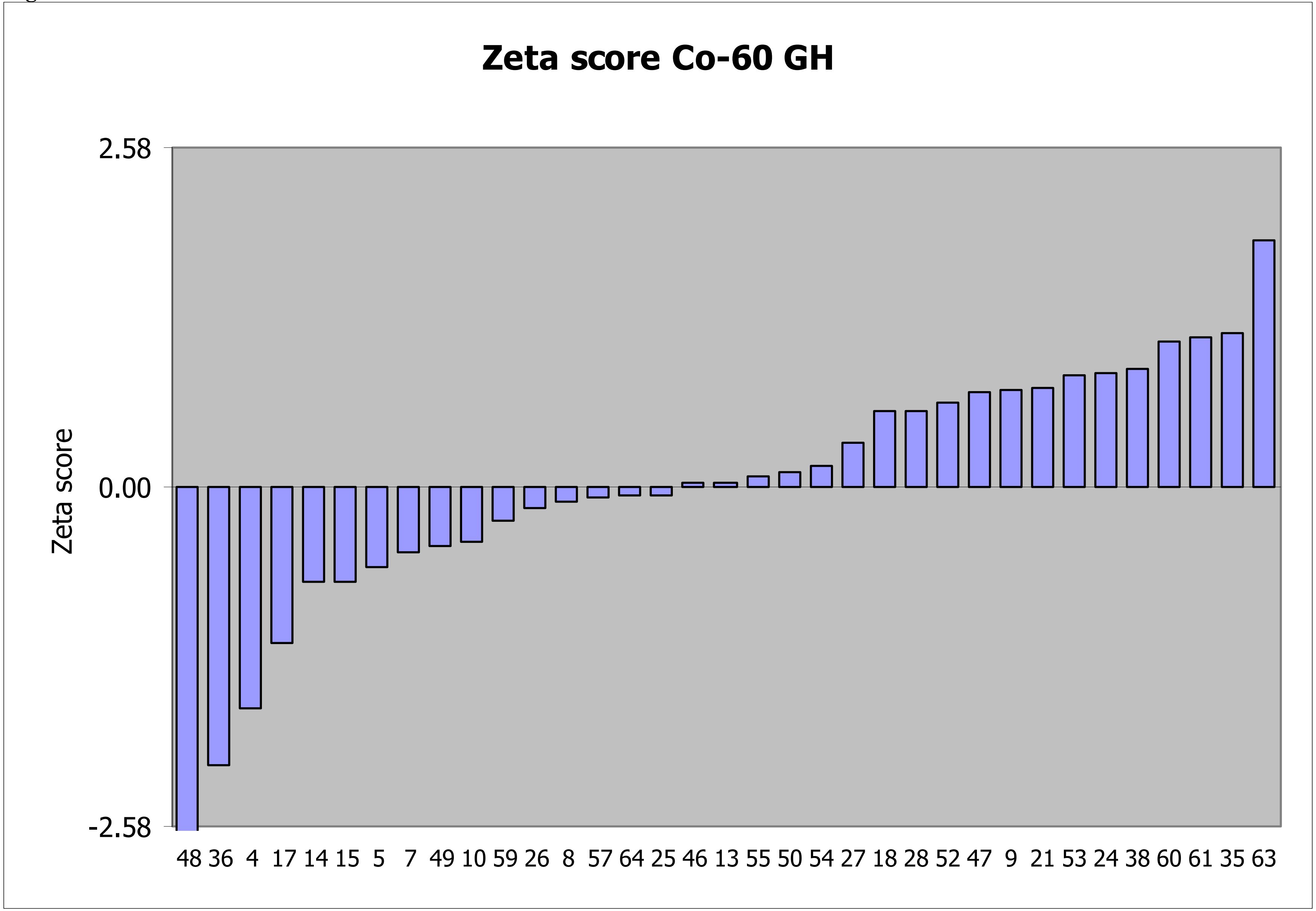


Figure 26C – Relative uncertainty Co-60 GH

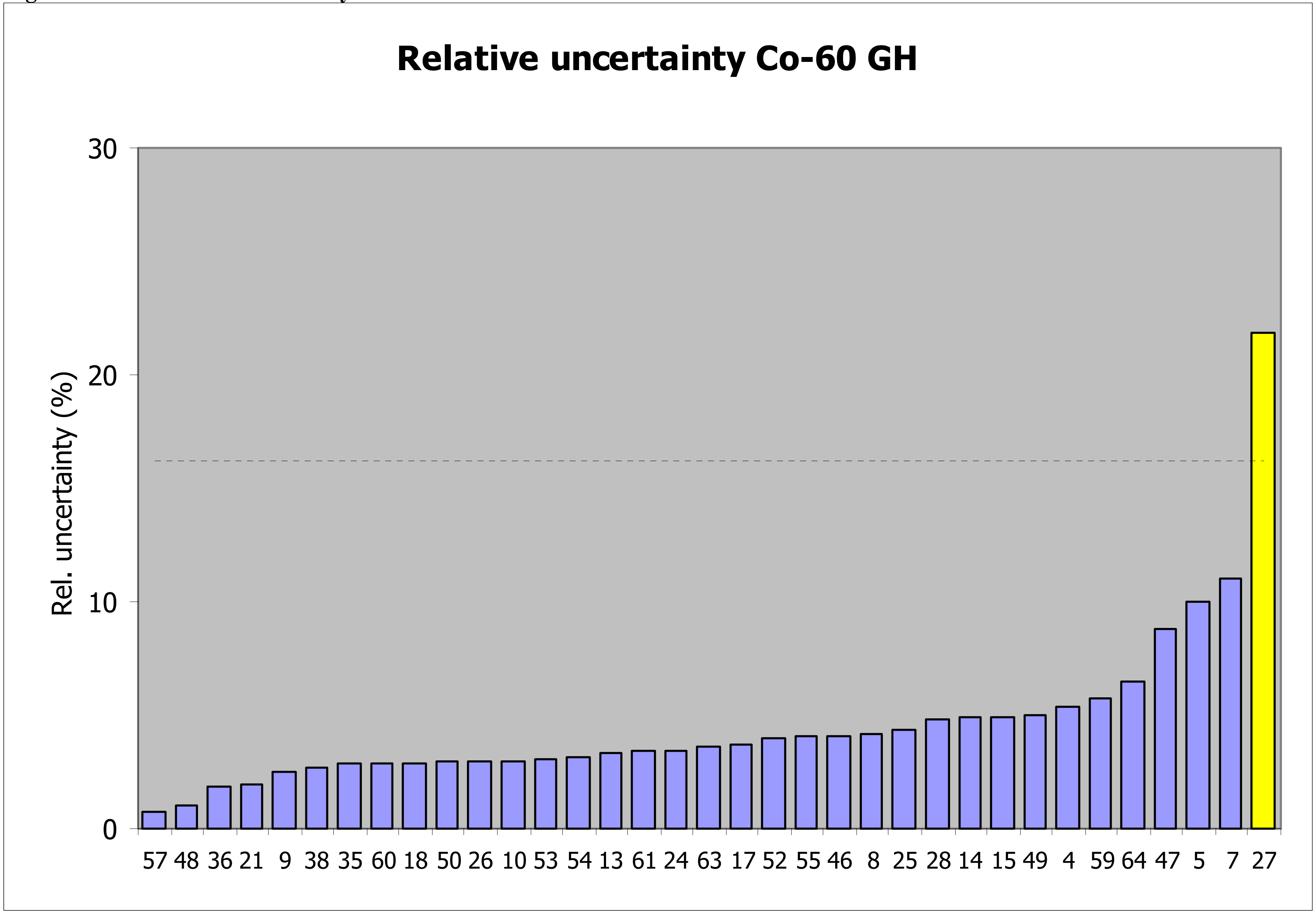


Figure 26D – Kiri plot Co-60 GH

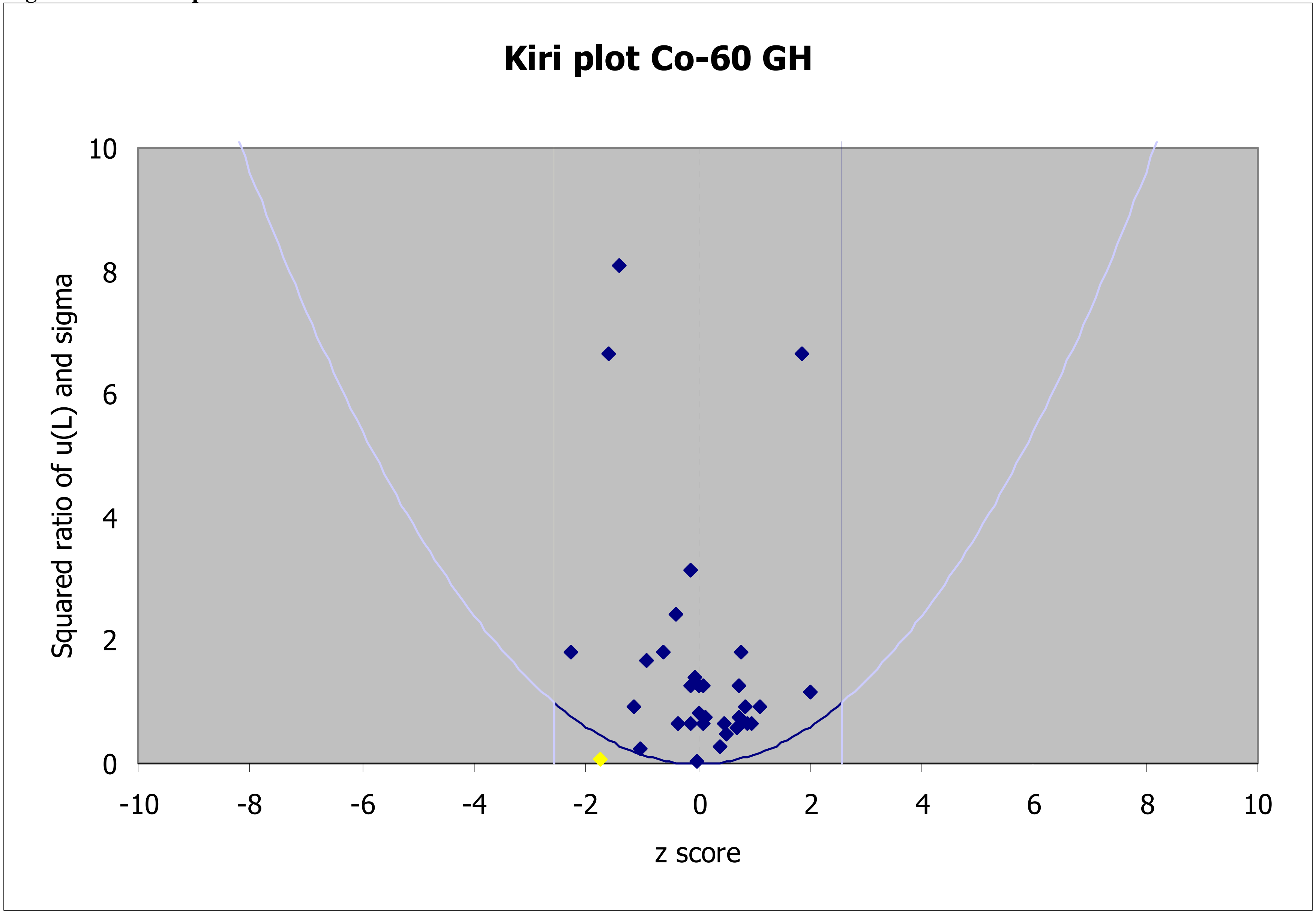


Figure 27A – Deviation Y-88 GH

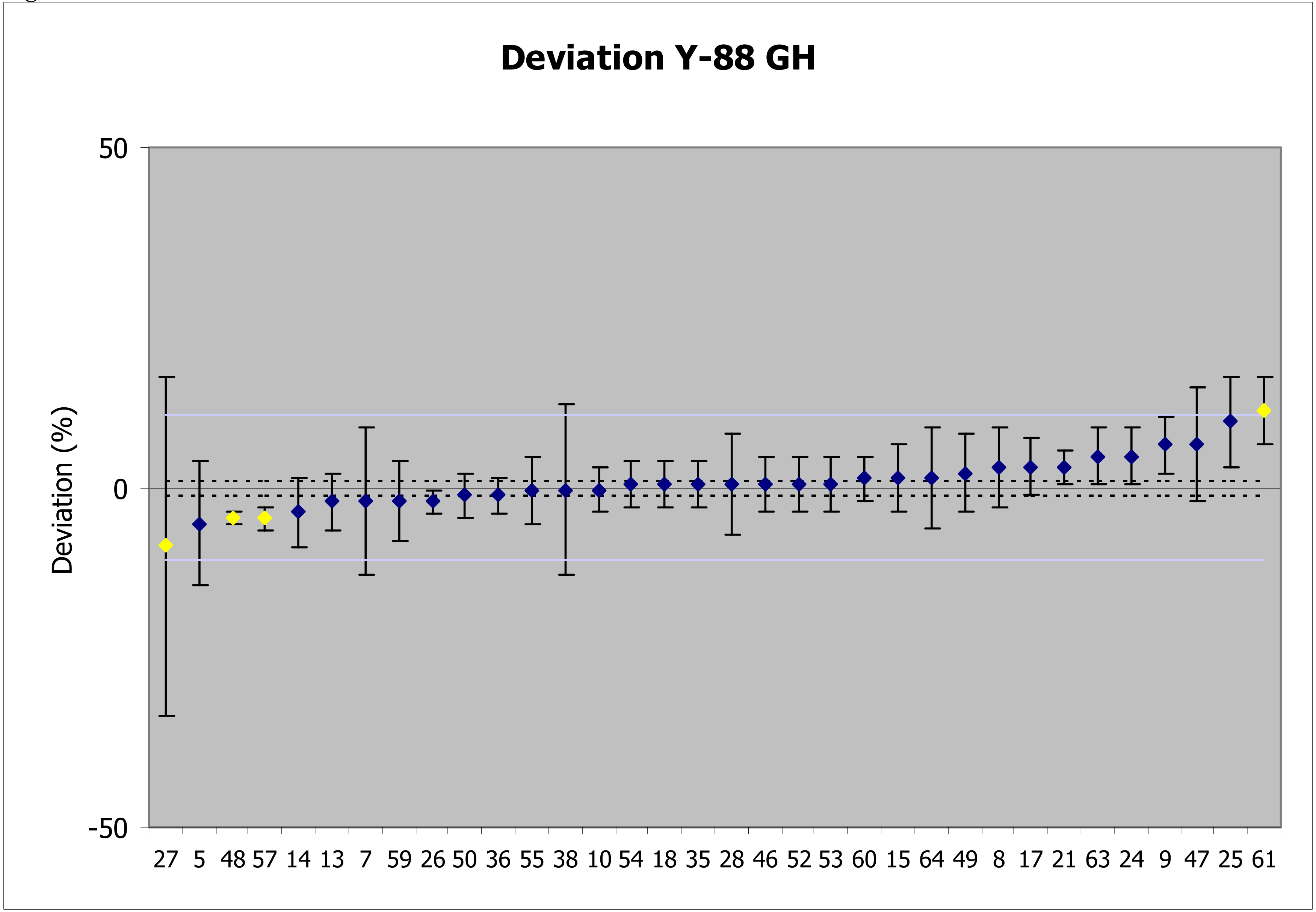


Figure 27B – Zeta score Y-88 GH

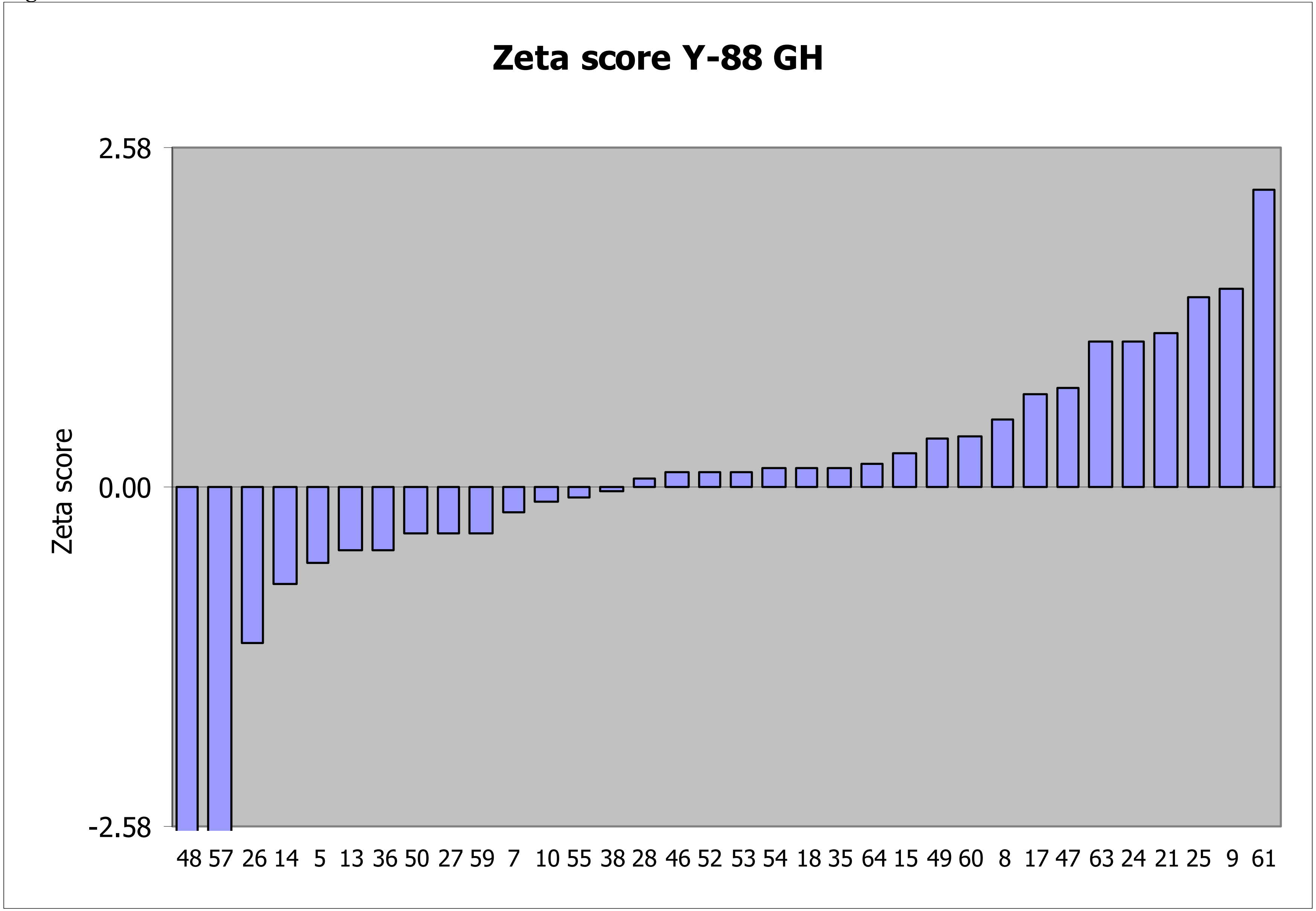


Figure 27C – Relative uncertainty Y-88 GH

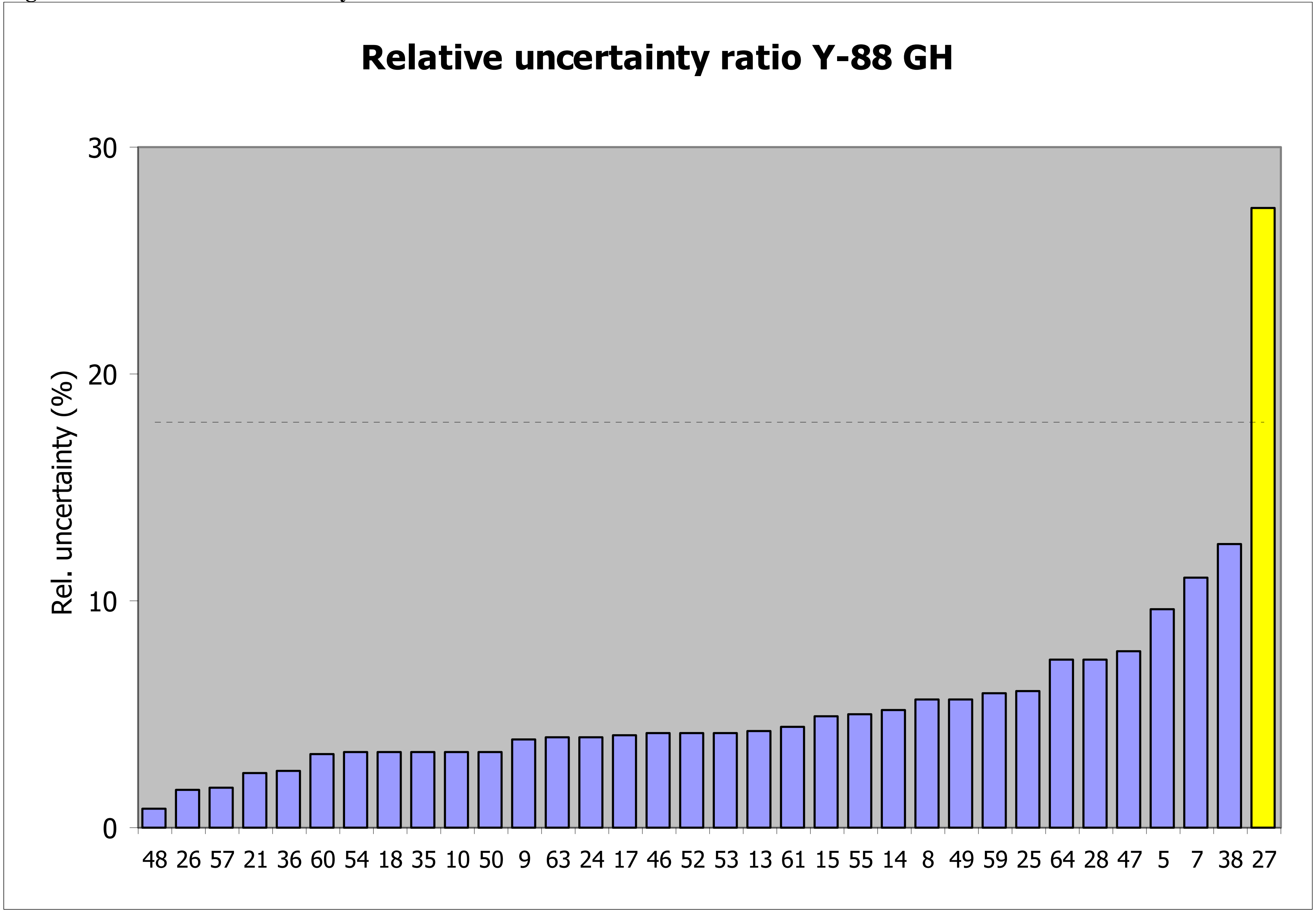


Figure 27D – Kiri plot Y-88 GH

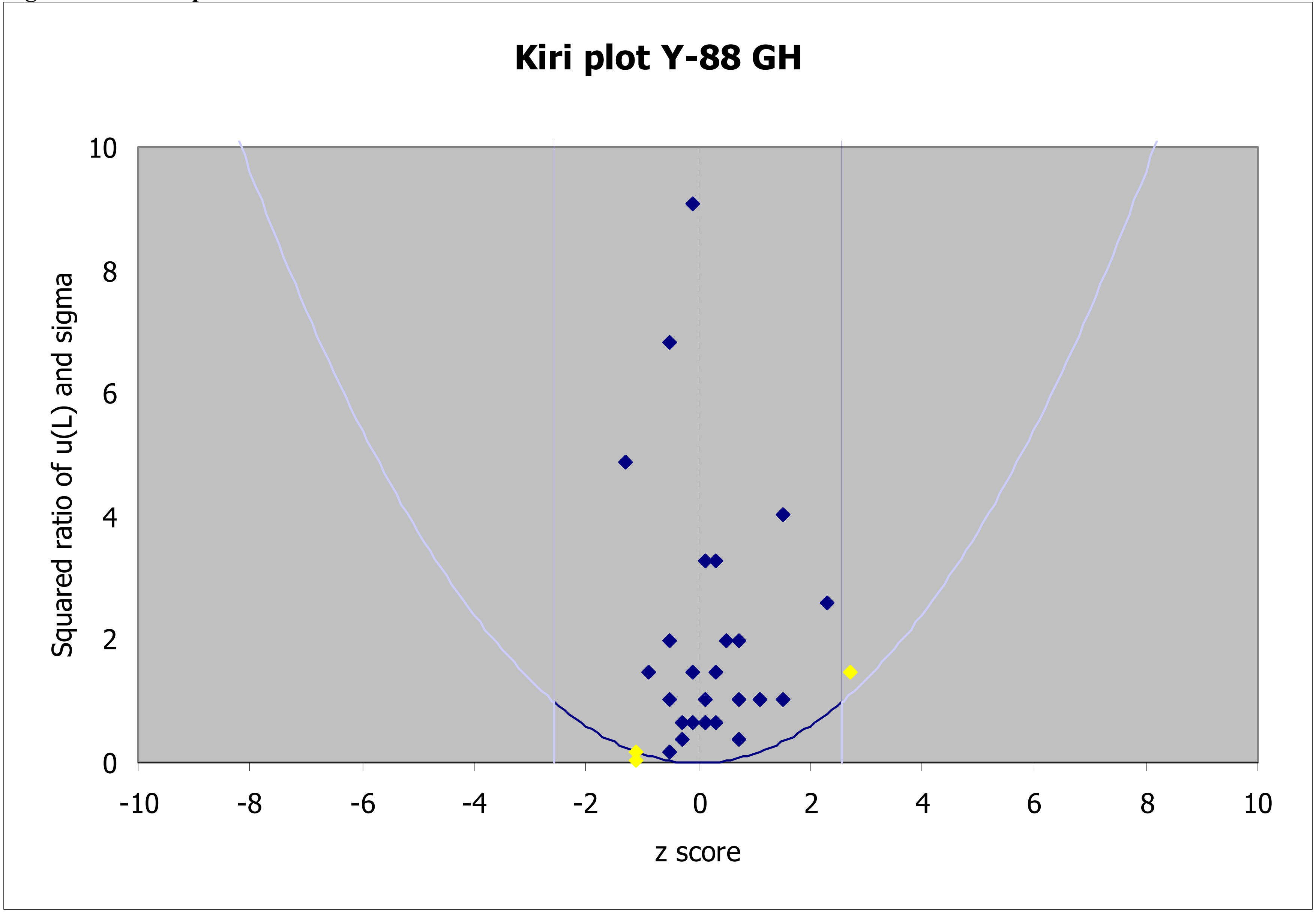


Figure 28A – Deviation Zr-95 GH

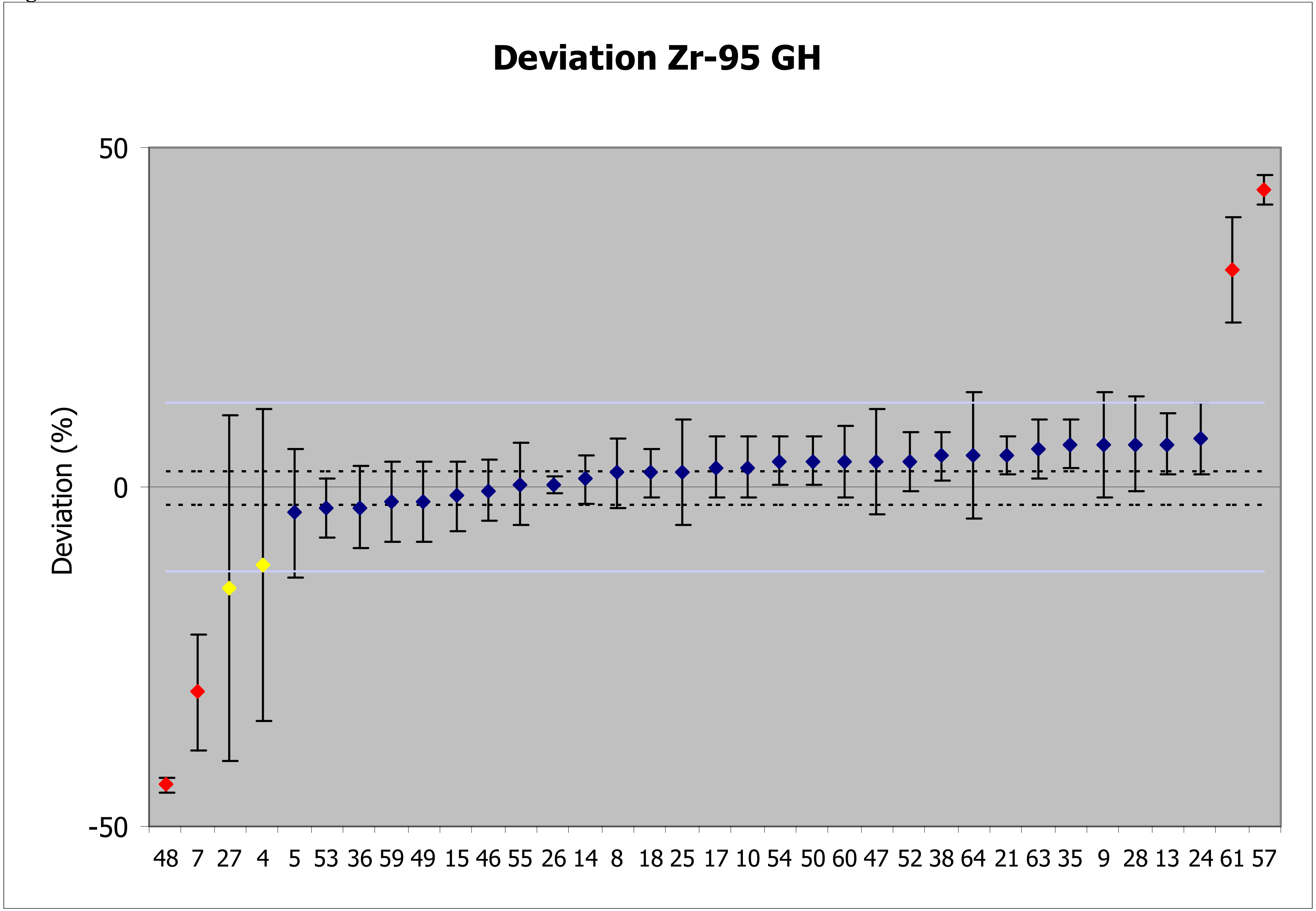


Figure 28B – Zeta score Zr-95 GH

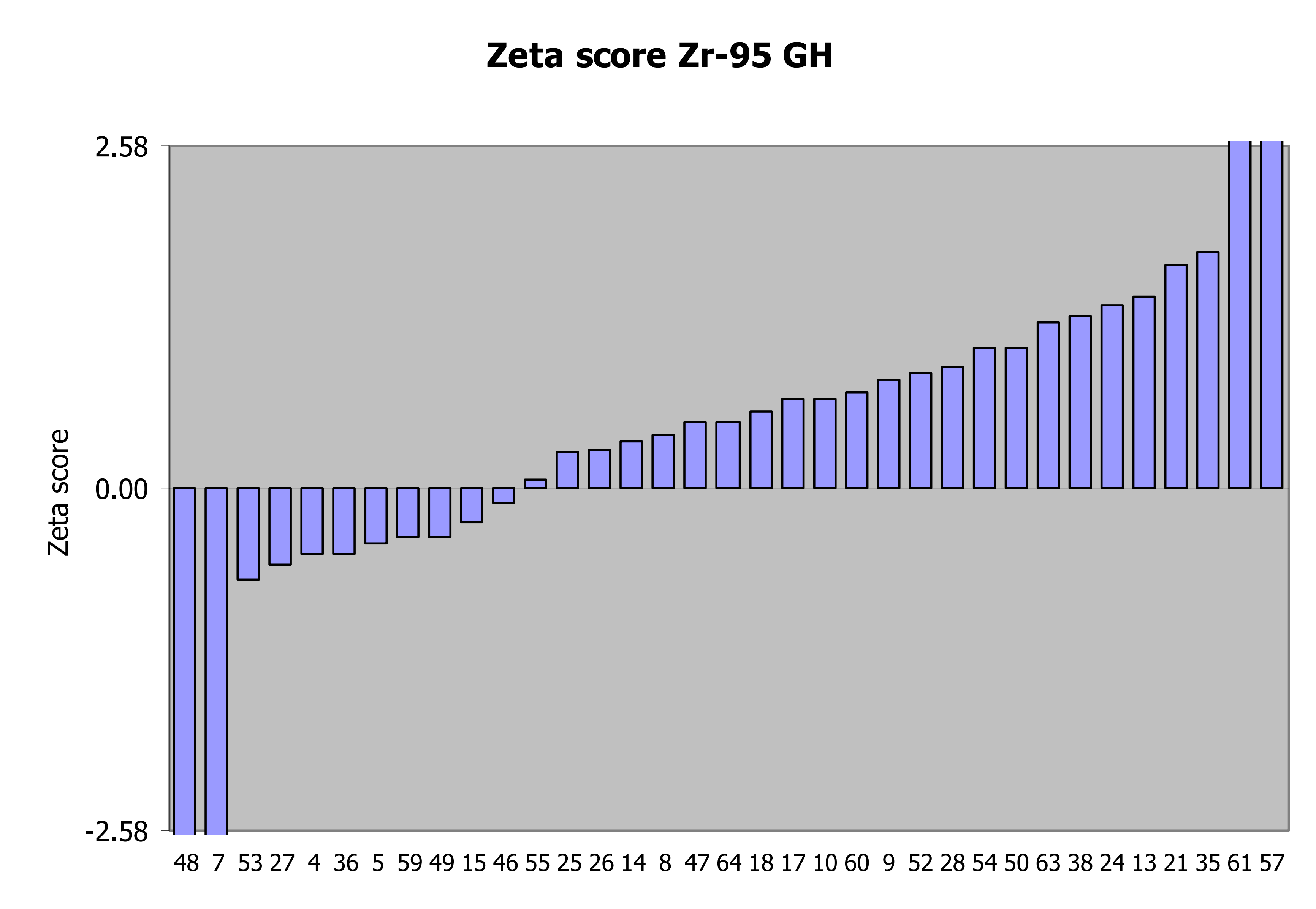


Figure 28C – Relative uncertainty Zr-95 GH

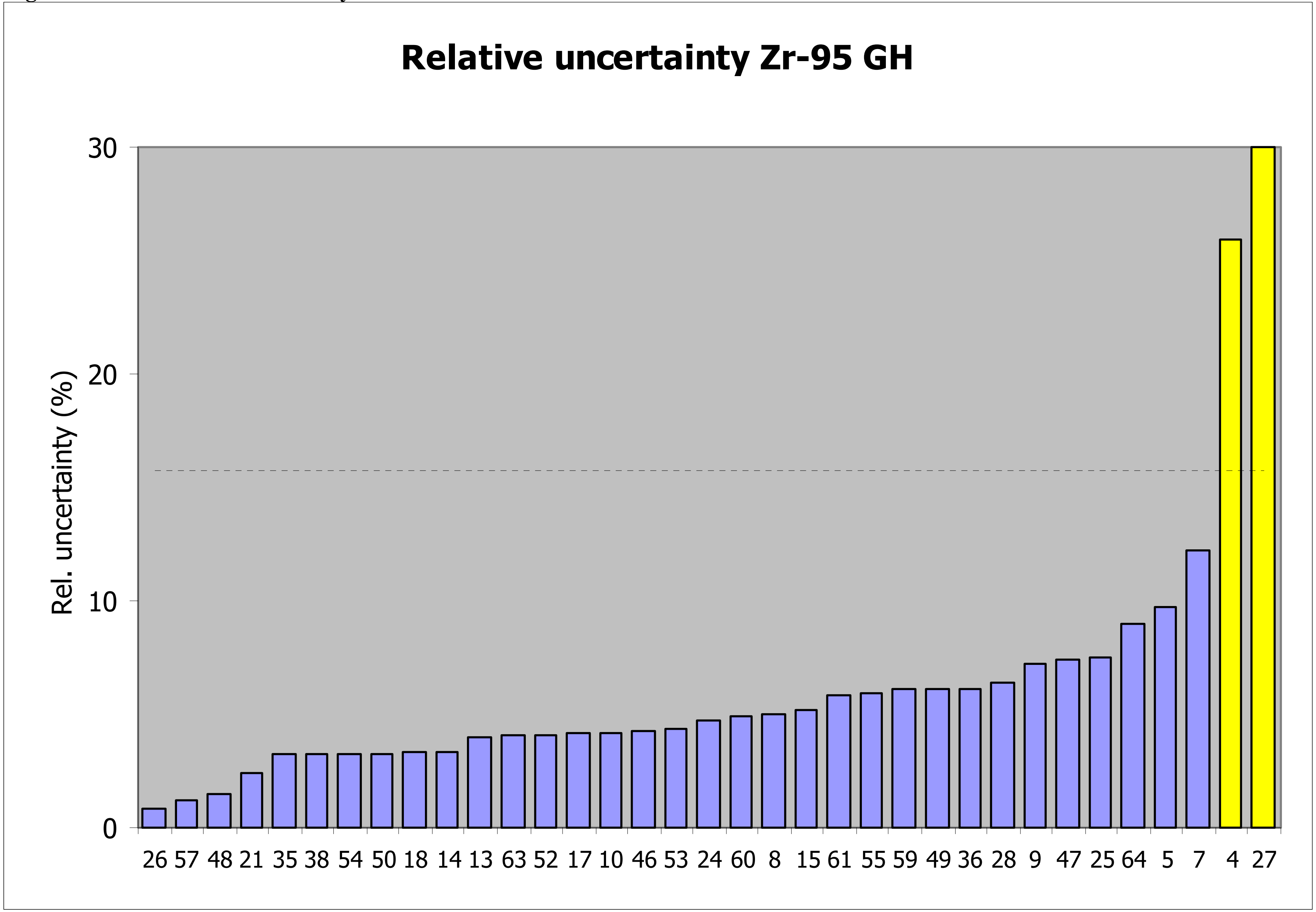


Figure 28D – Kiri plot Zr-95 GH

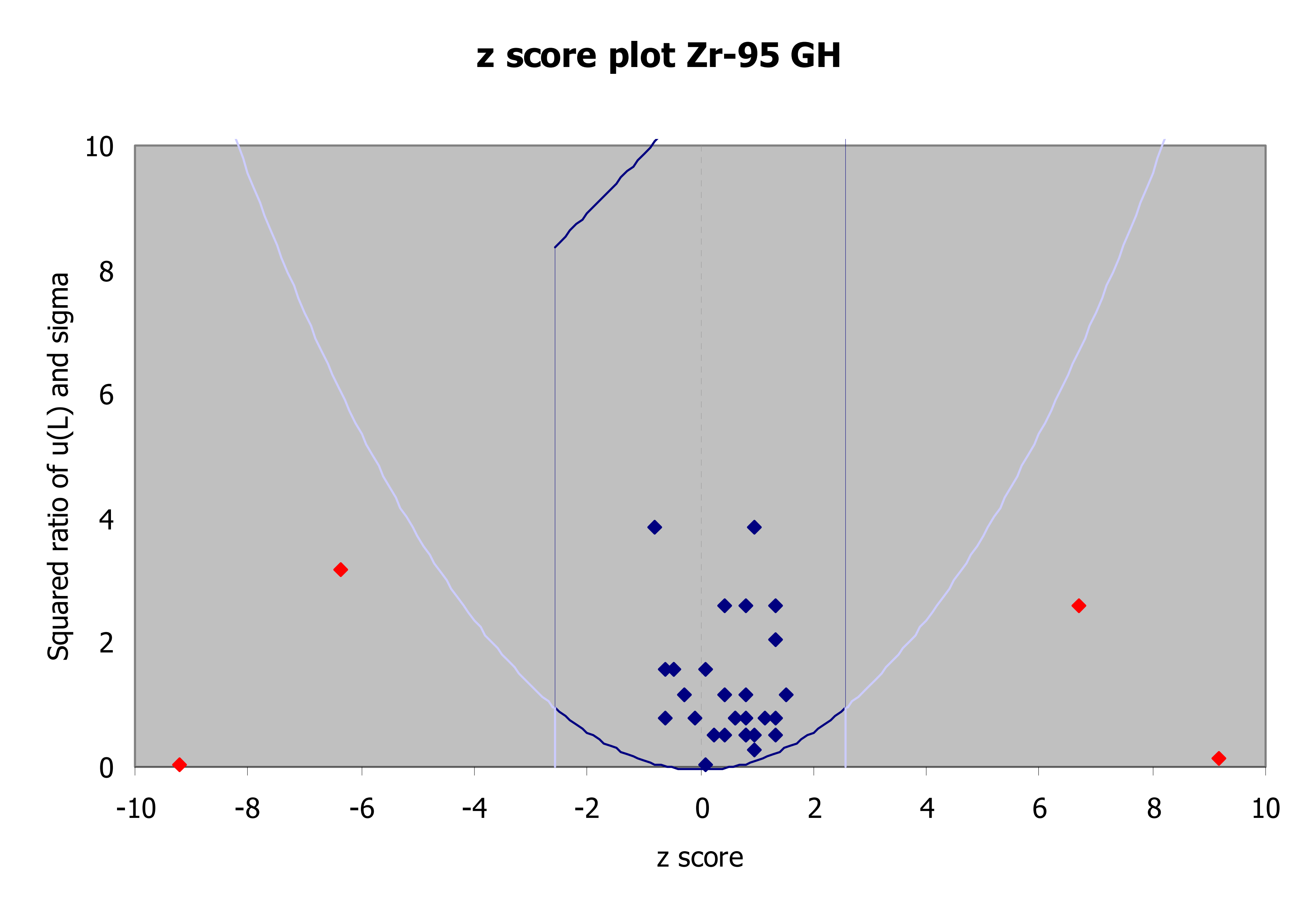


Figure 29A – Deviation Nb-95 GH

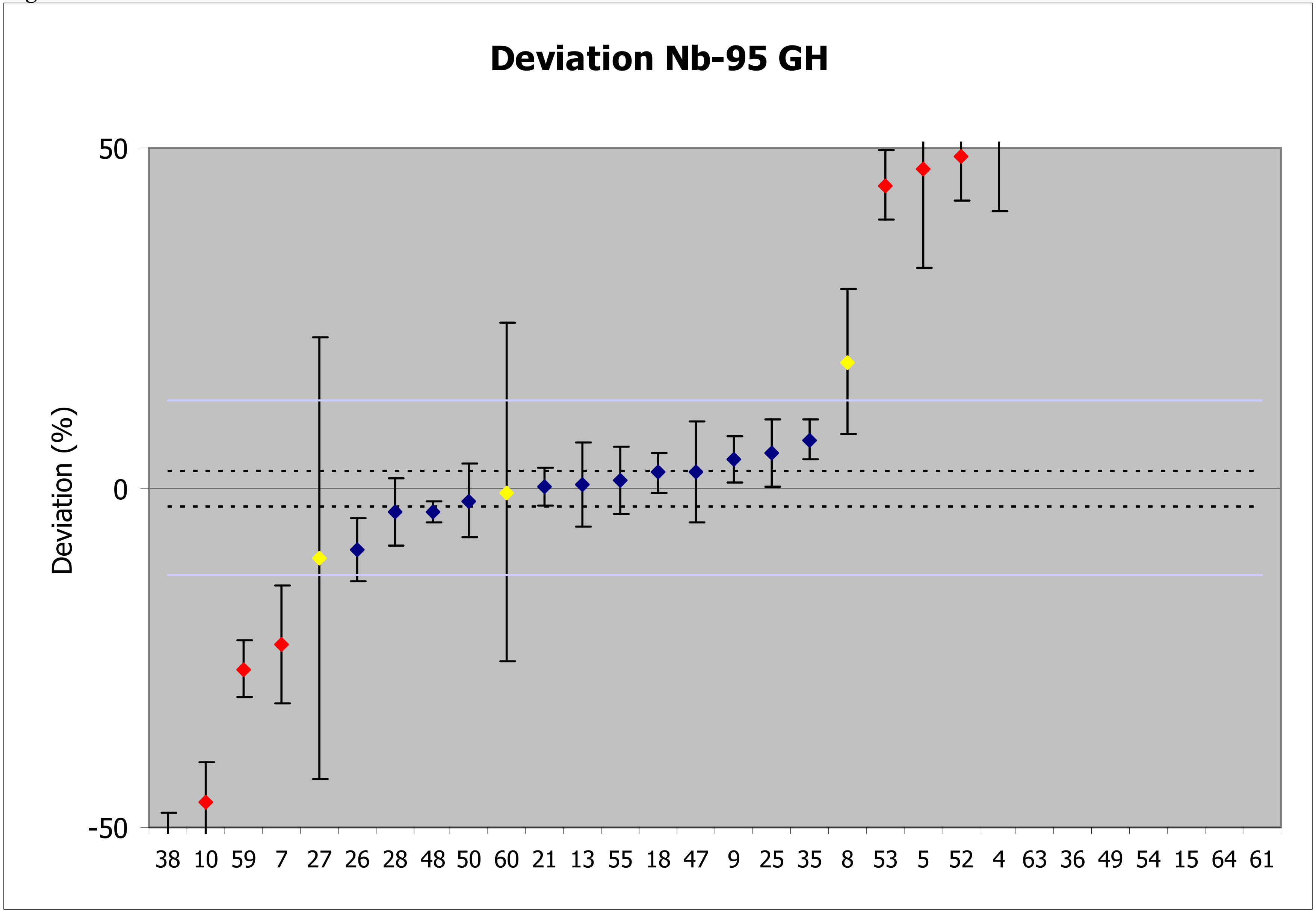


Figure 29B – Zeta score Nb-95 GH

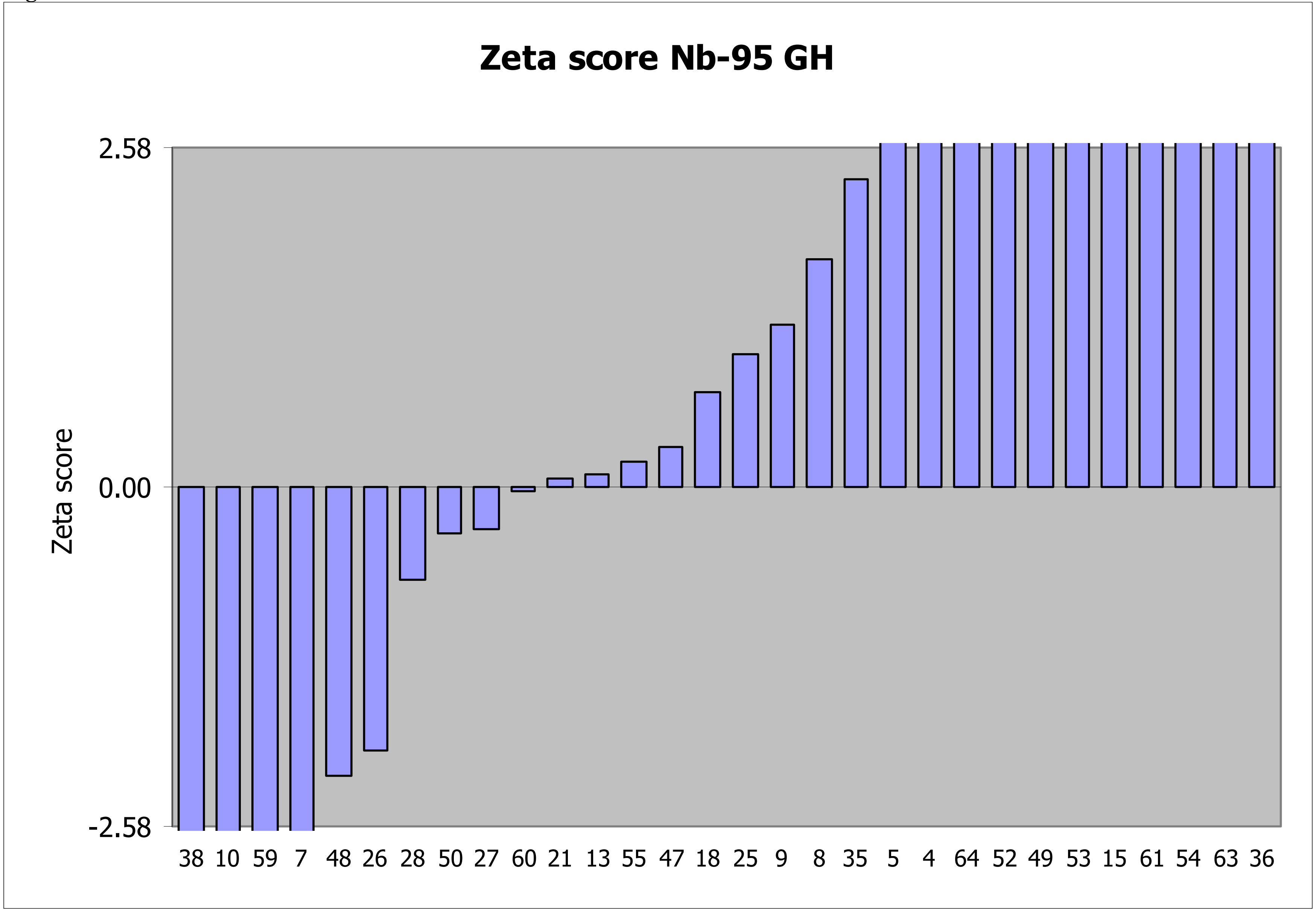


Figure 29C – Relative uncertainty Nb-95 GH

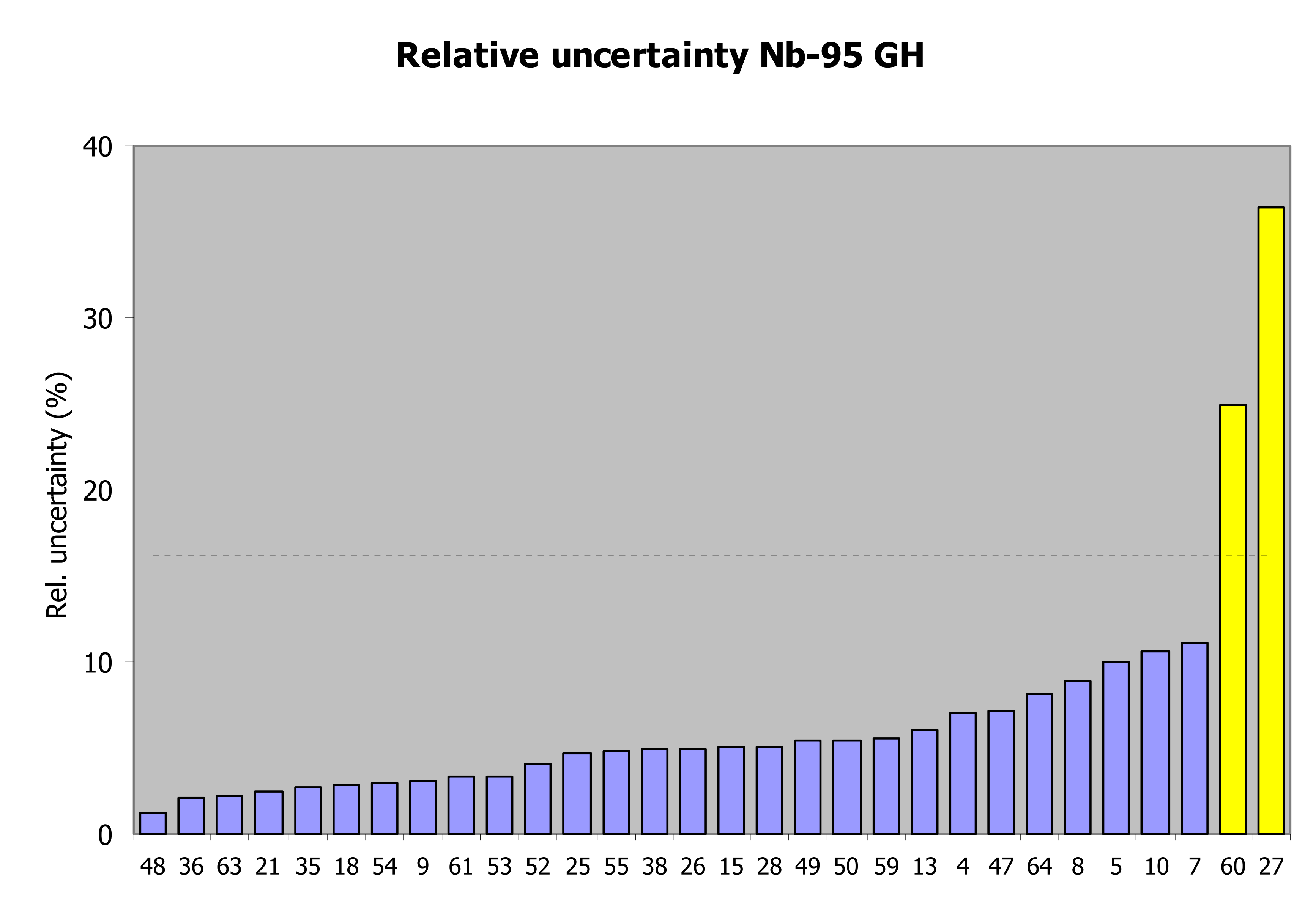


Figure 29D – Kiri plot Nb-95 GH

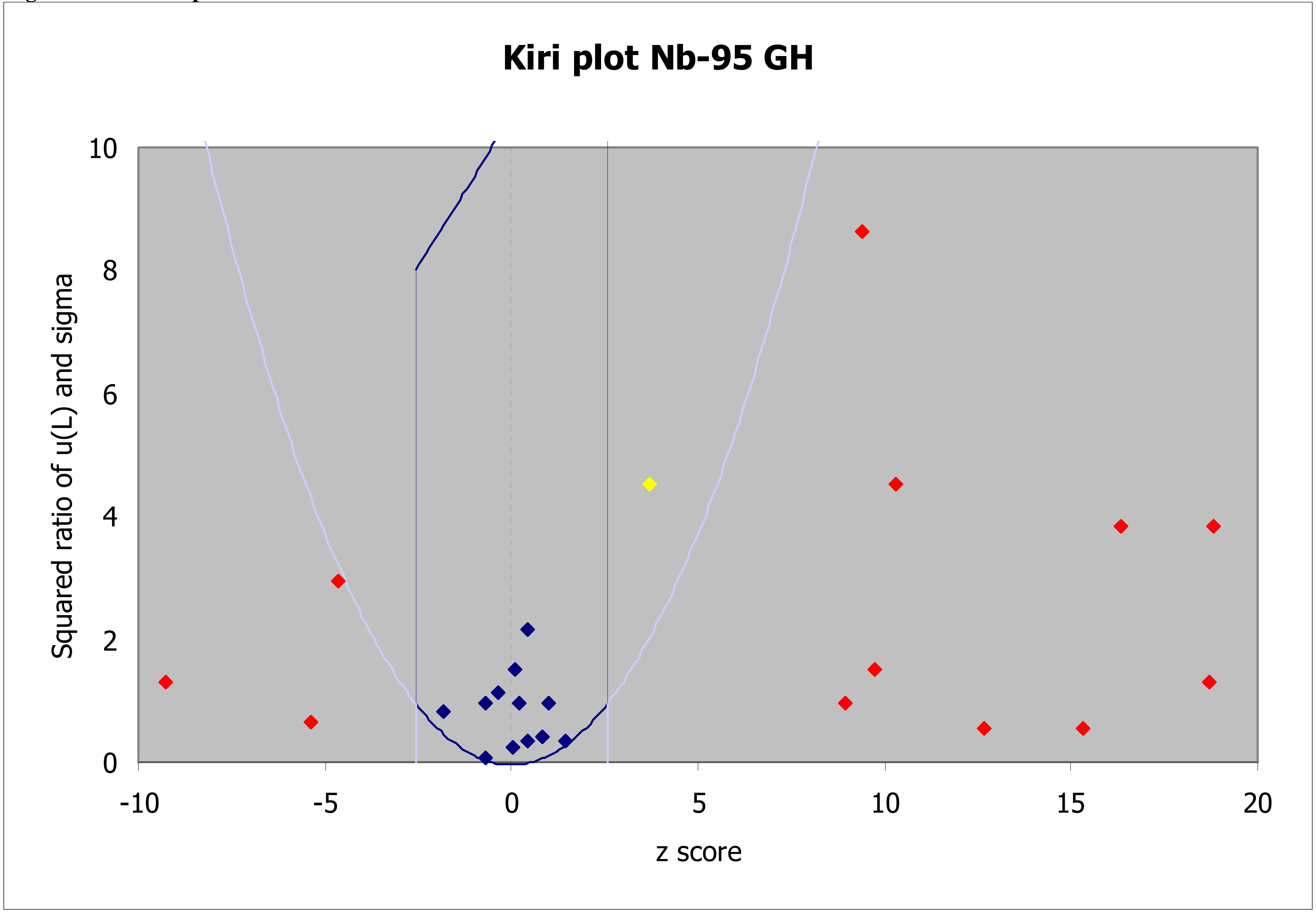


Figure 30A – Deviation Sb-125 GH

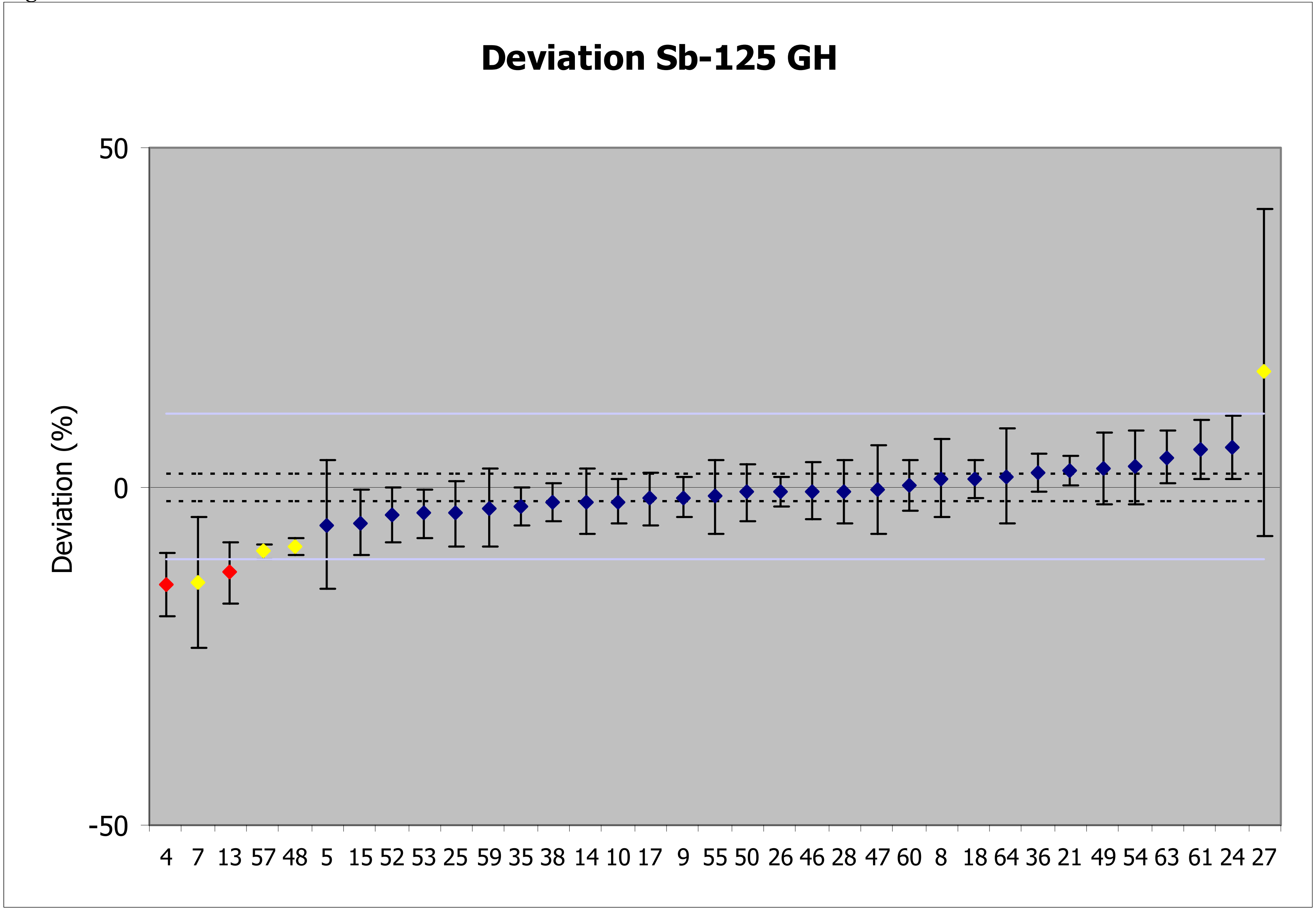


Figure 30B – Zeta score Sb-125 GH

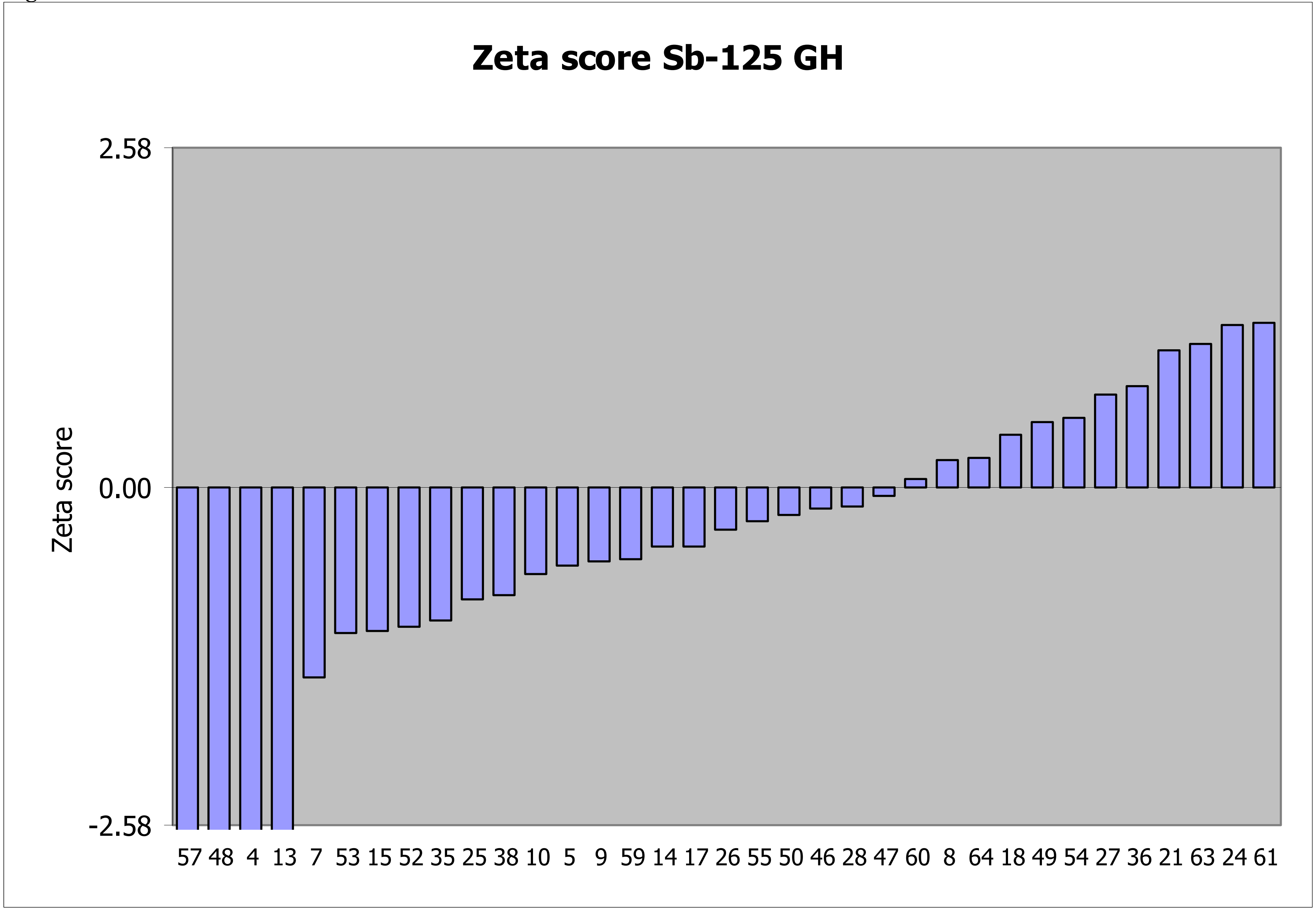


Figure 30C – Relative uncertainty Sb-125 GH

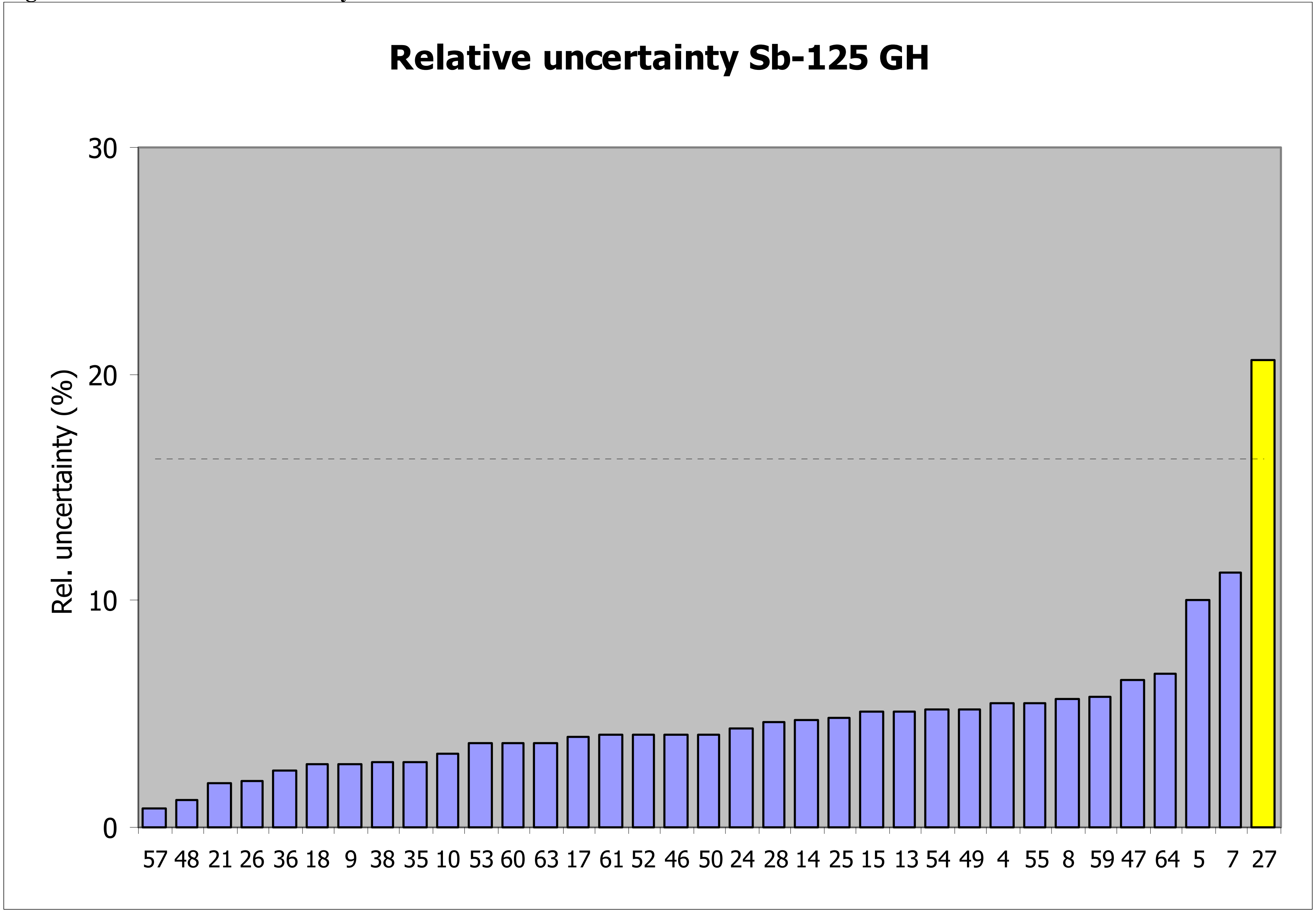


Figure 30D – Kiri plot Sb-125 GH

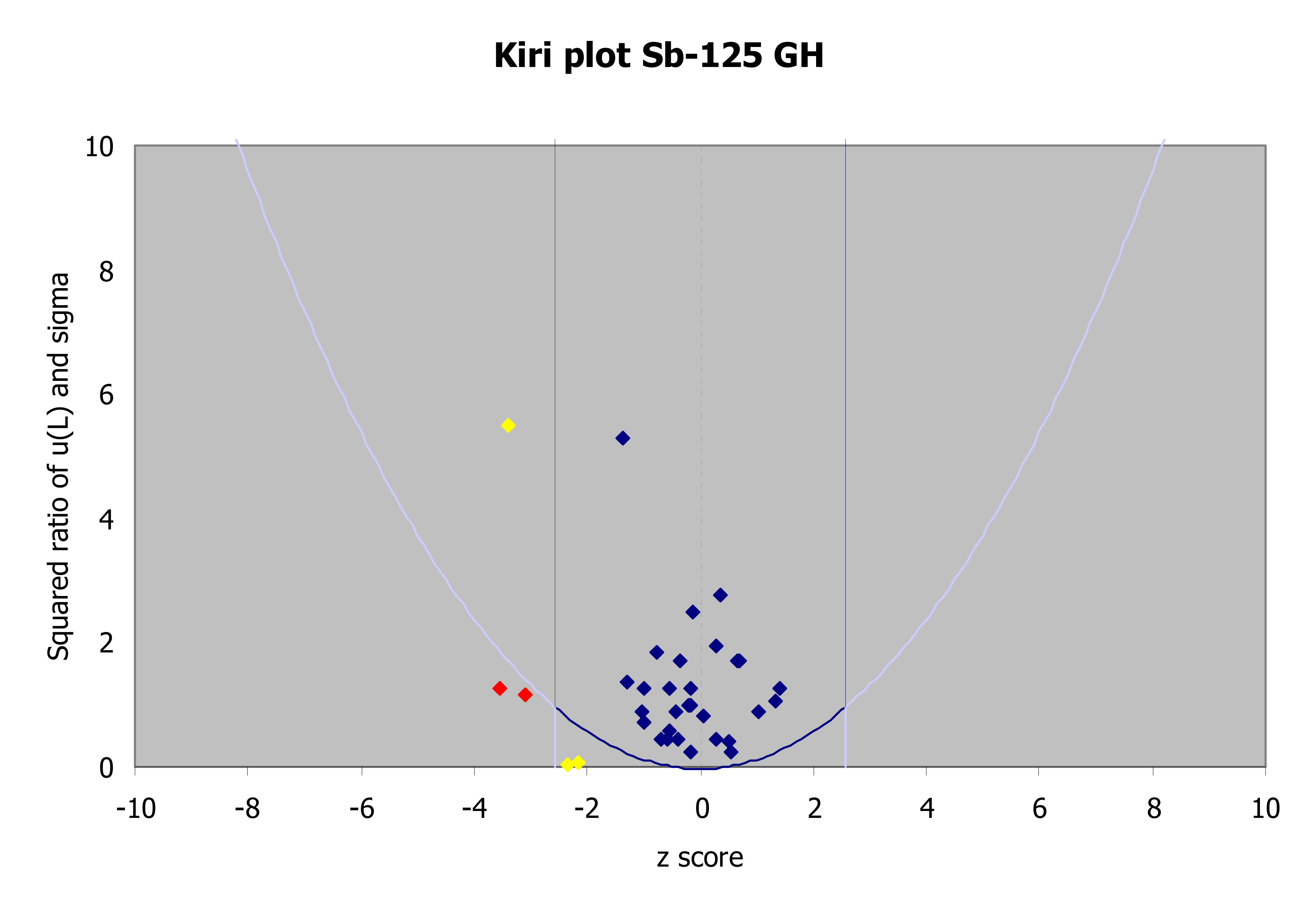


Figure 31A – Deviation Ba-133 GH

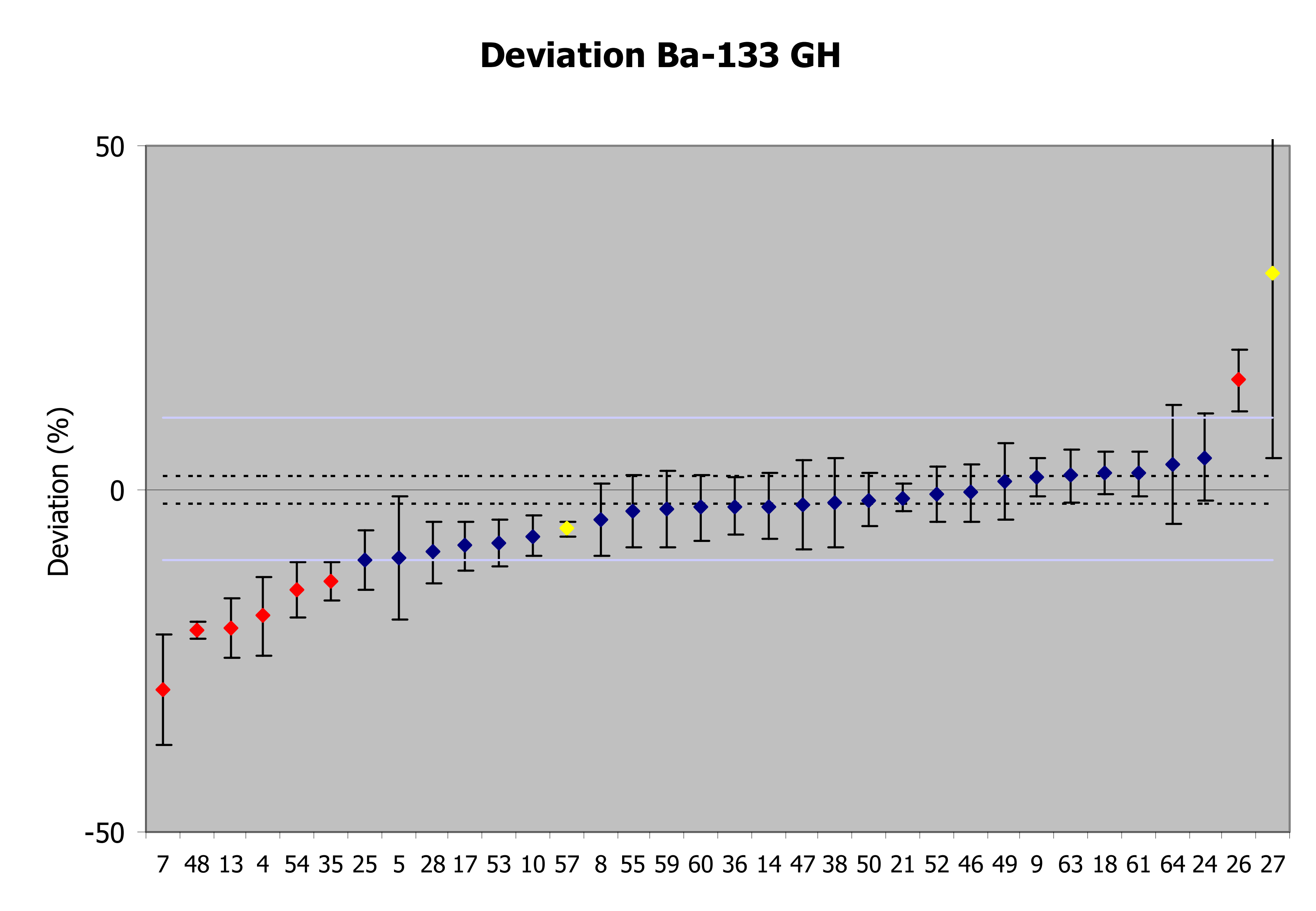


Figure 31B – Zeta score Ba-133 GH

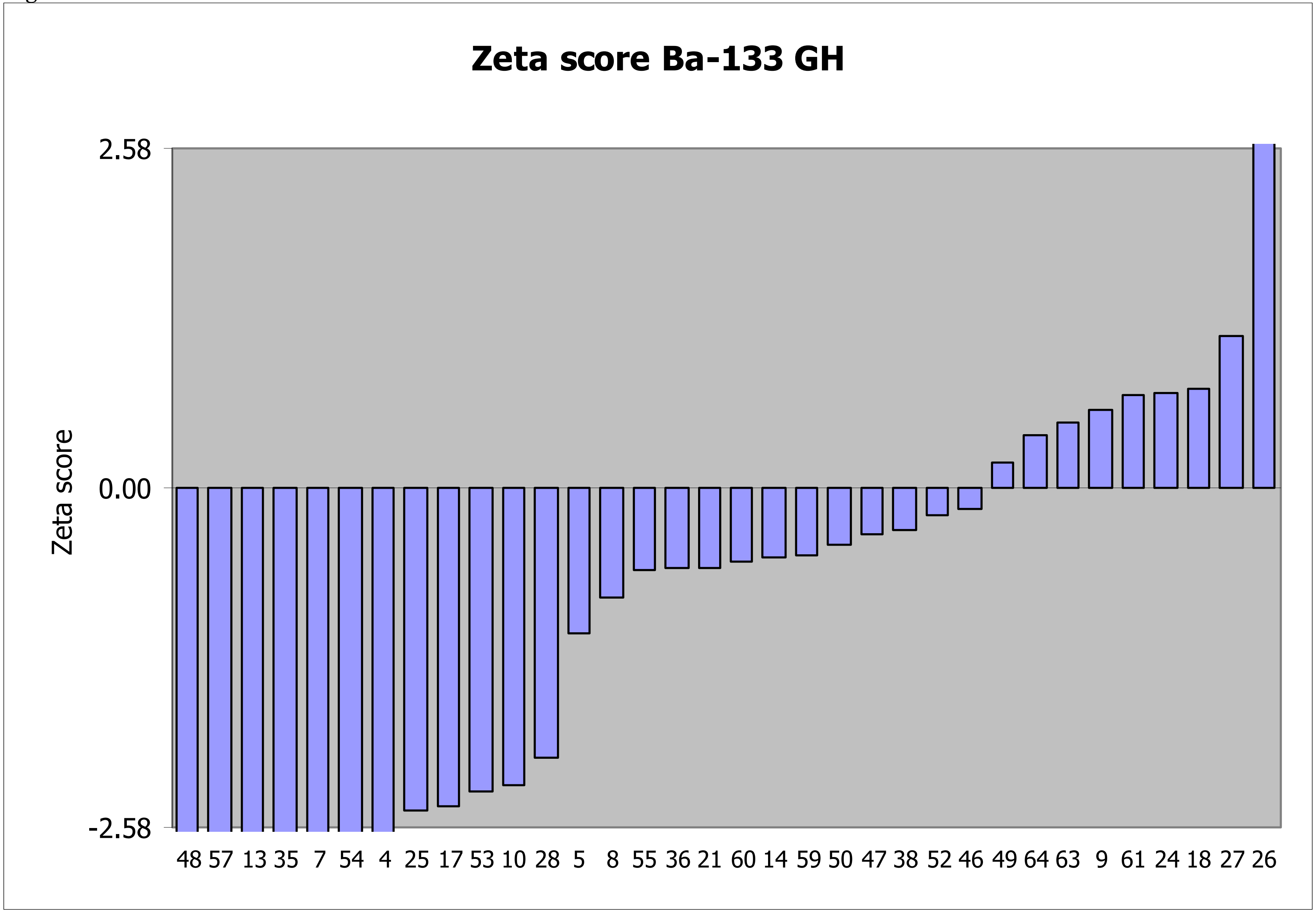


Figure 31C – Relative uncertainty Ba-133 GH

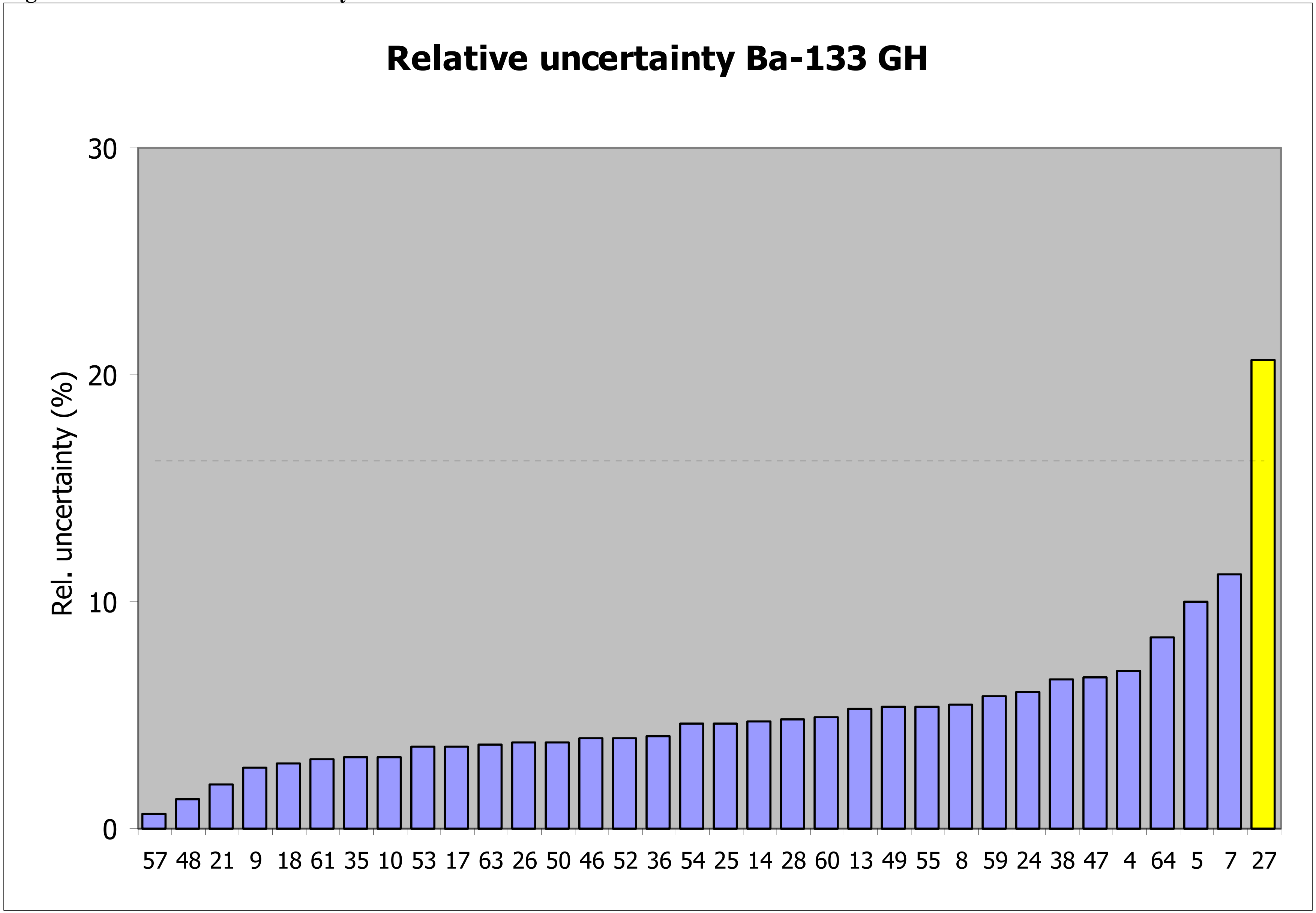


Figure 31D – Kiri plot Ba-133 GH

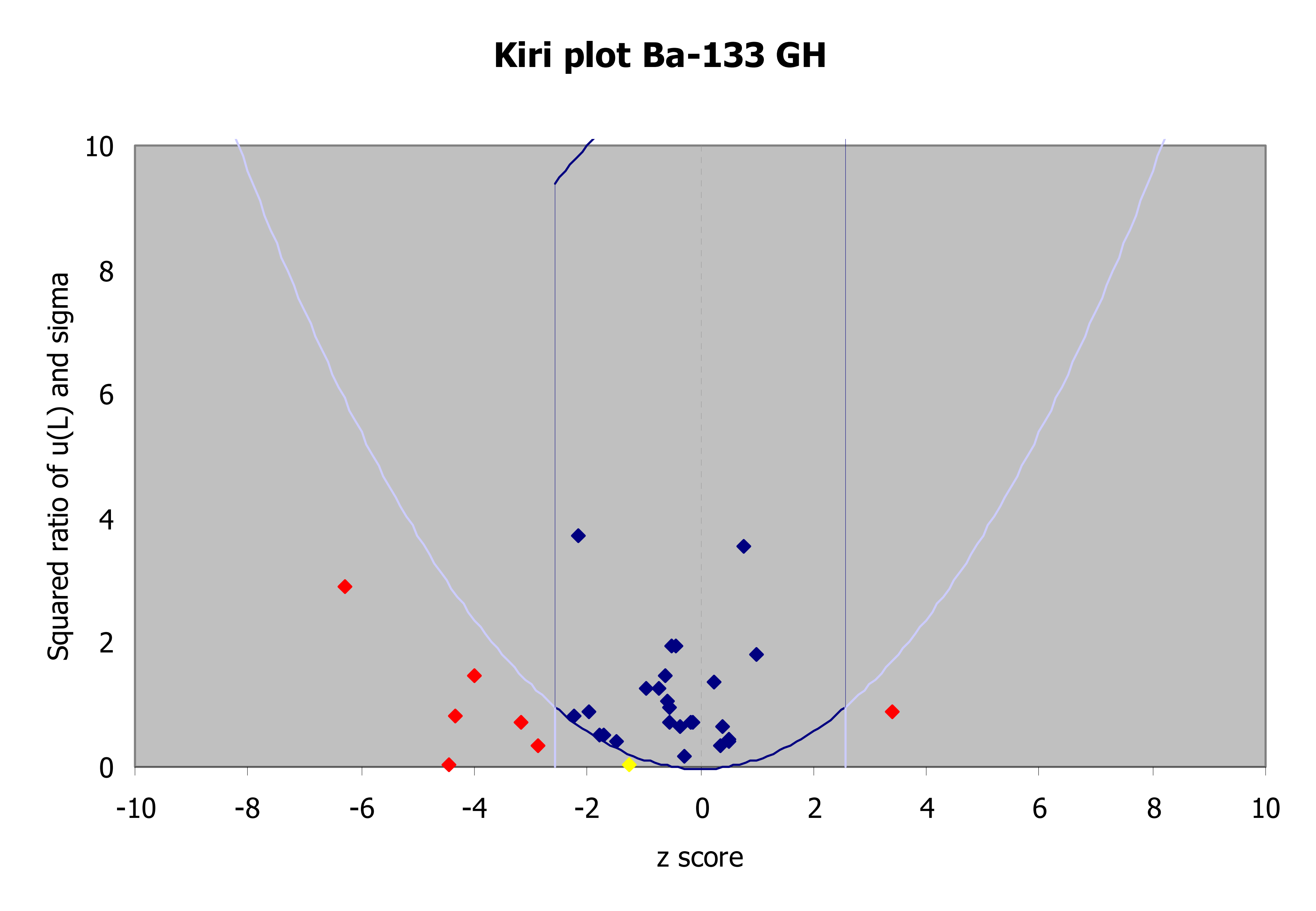


Figure 32A – Deviation Cs-134 GH

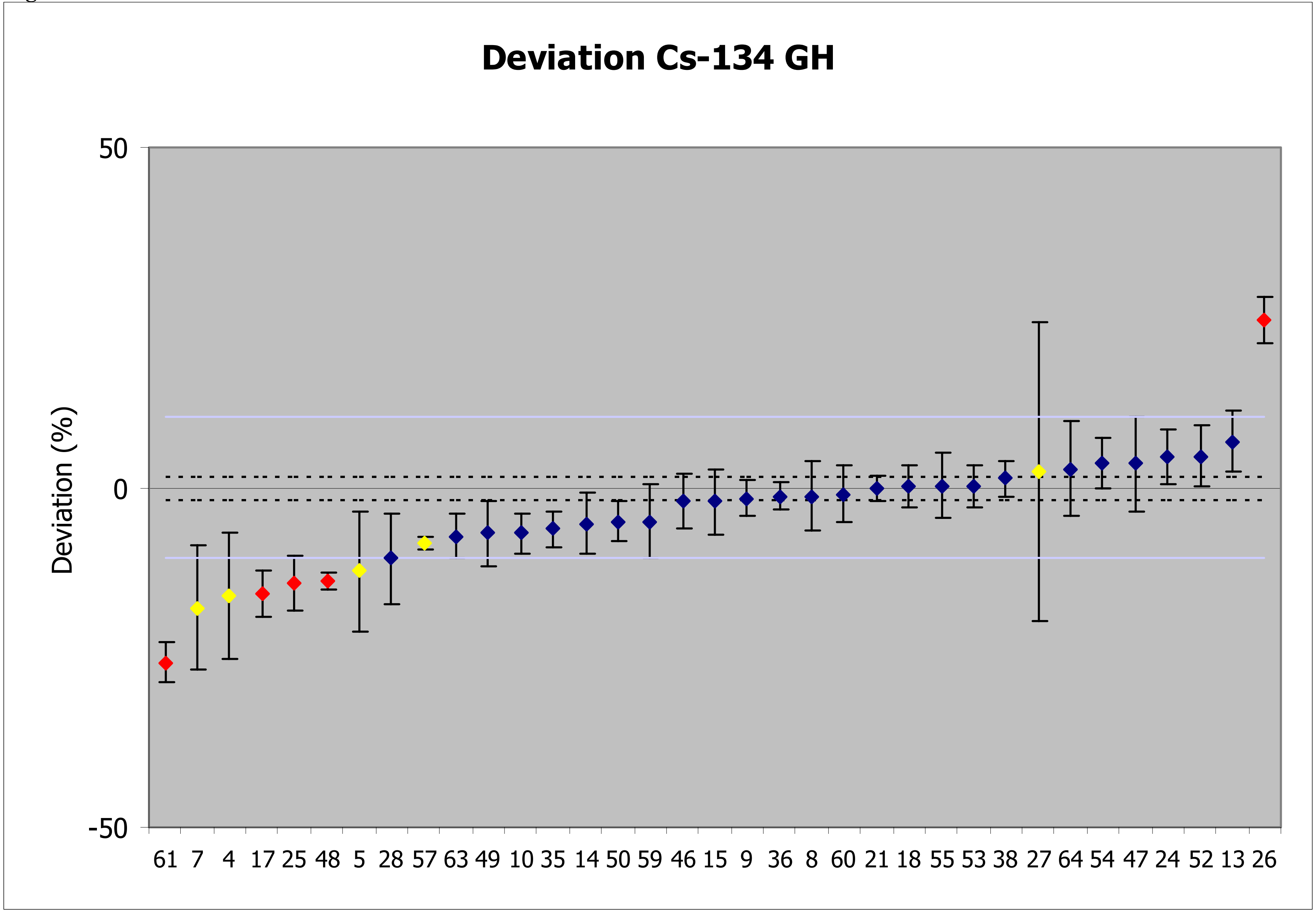


Figure 32B – Zeta score Cs-134 GH

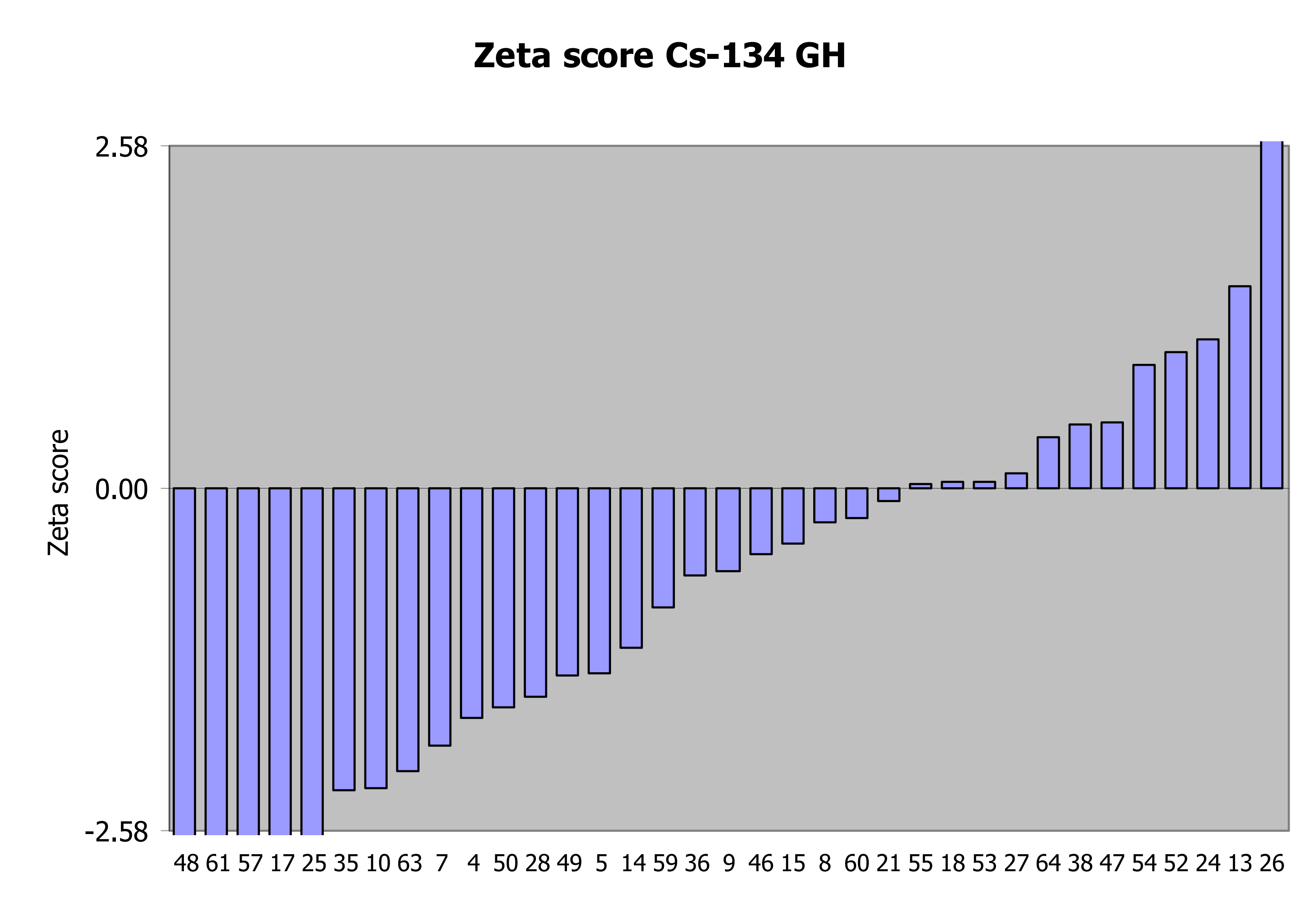


Figure 32C – Relative uncertainty Cs-134 GH

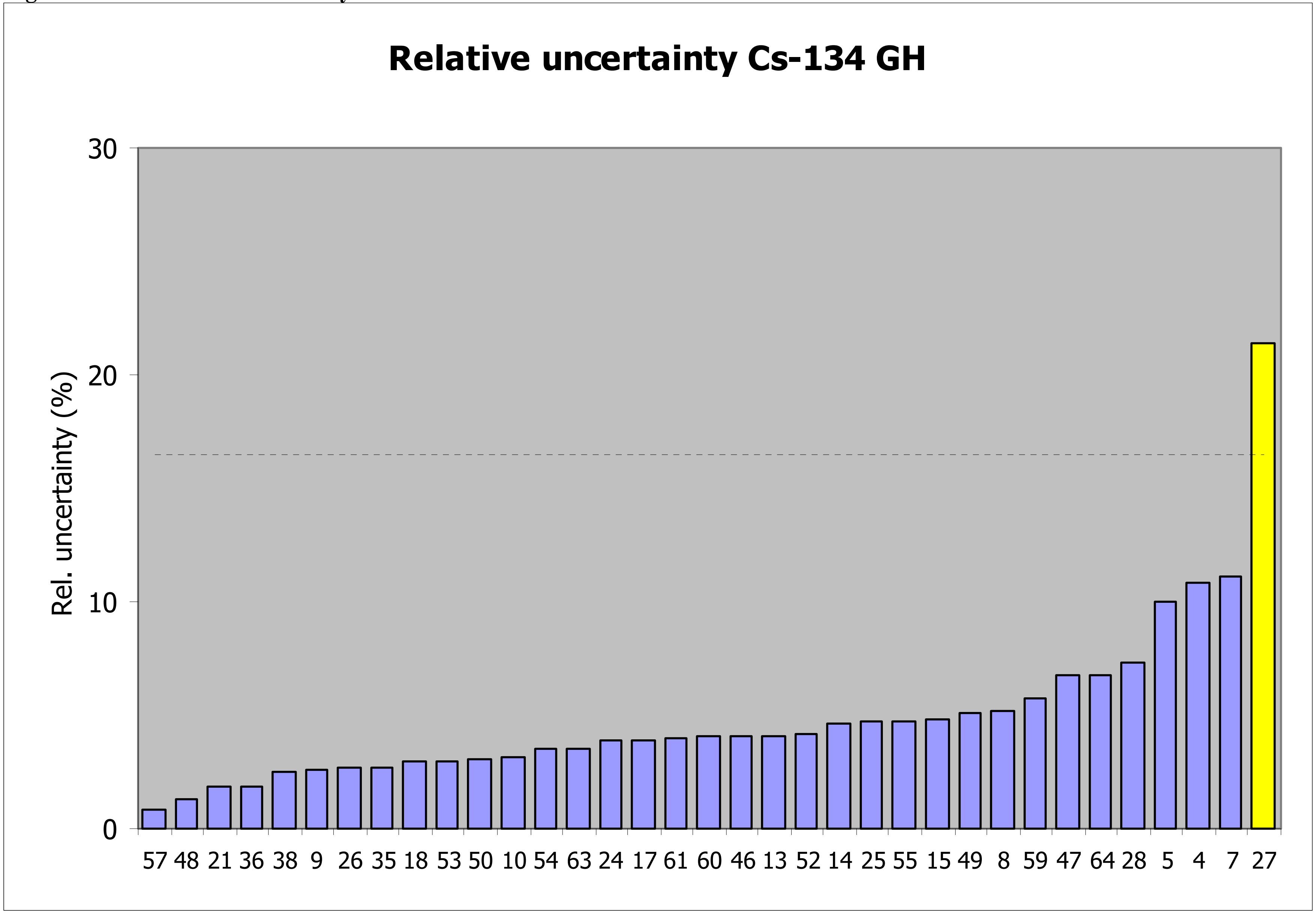


Figure 32D – Kiri plot Cs-134 GH

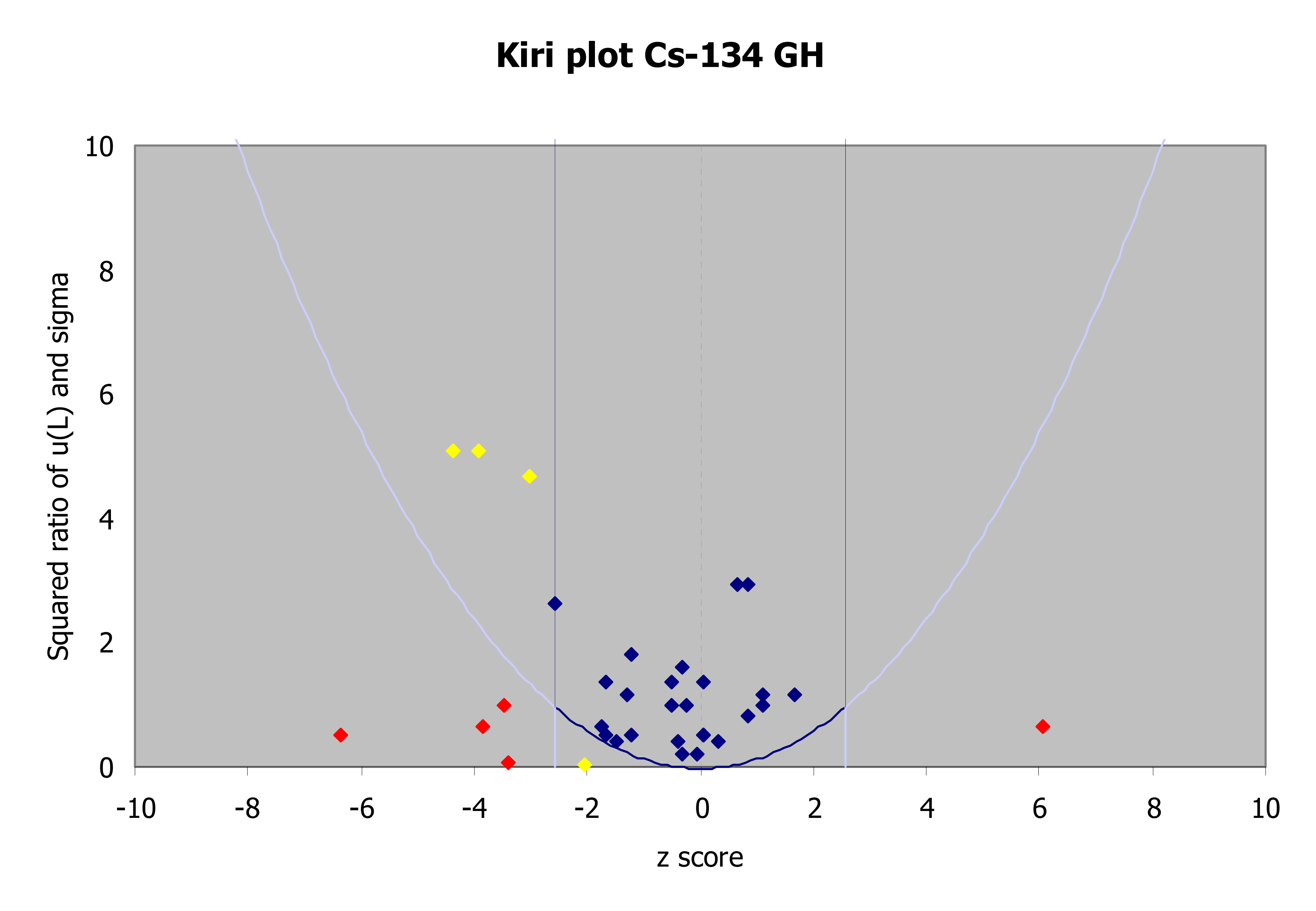


Figure 33A – Deviation Cs-137 GH

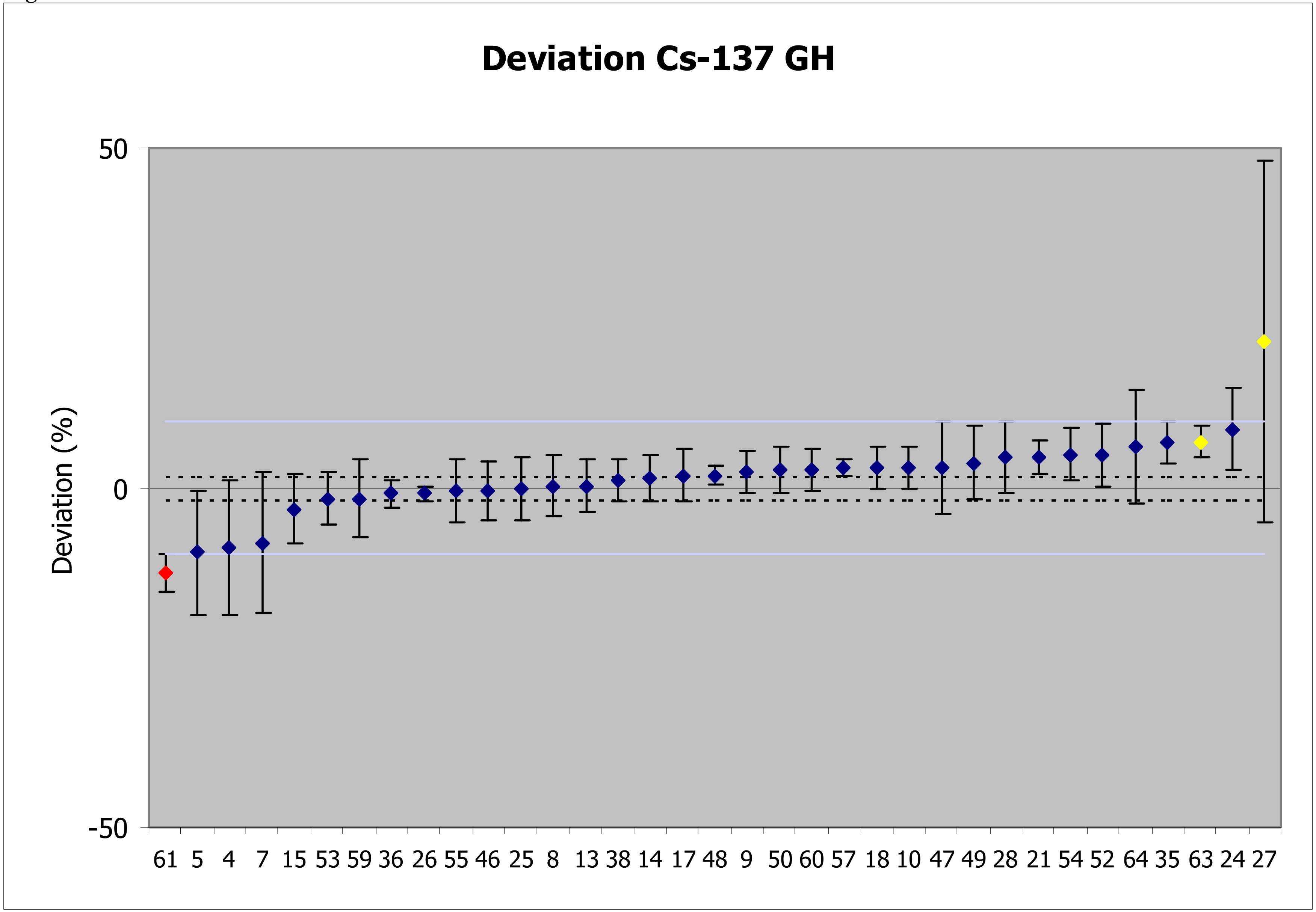


Figure 33B – Zeta score Cs-137 GH

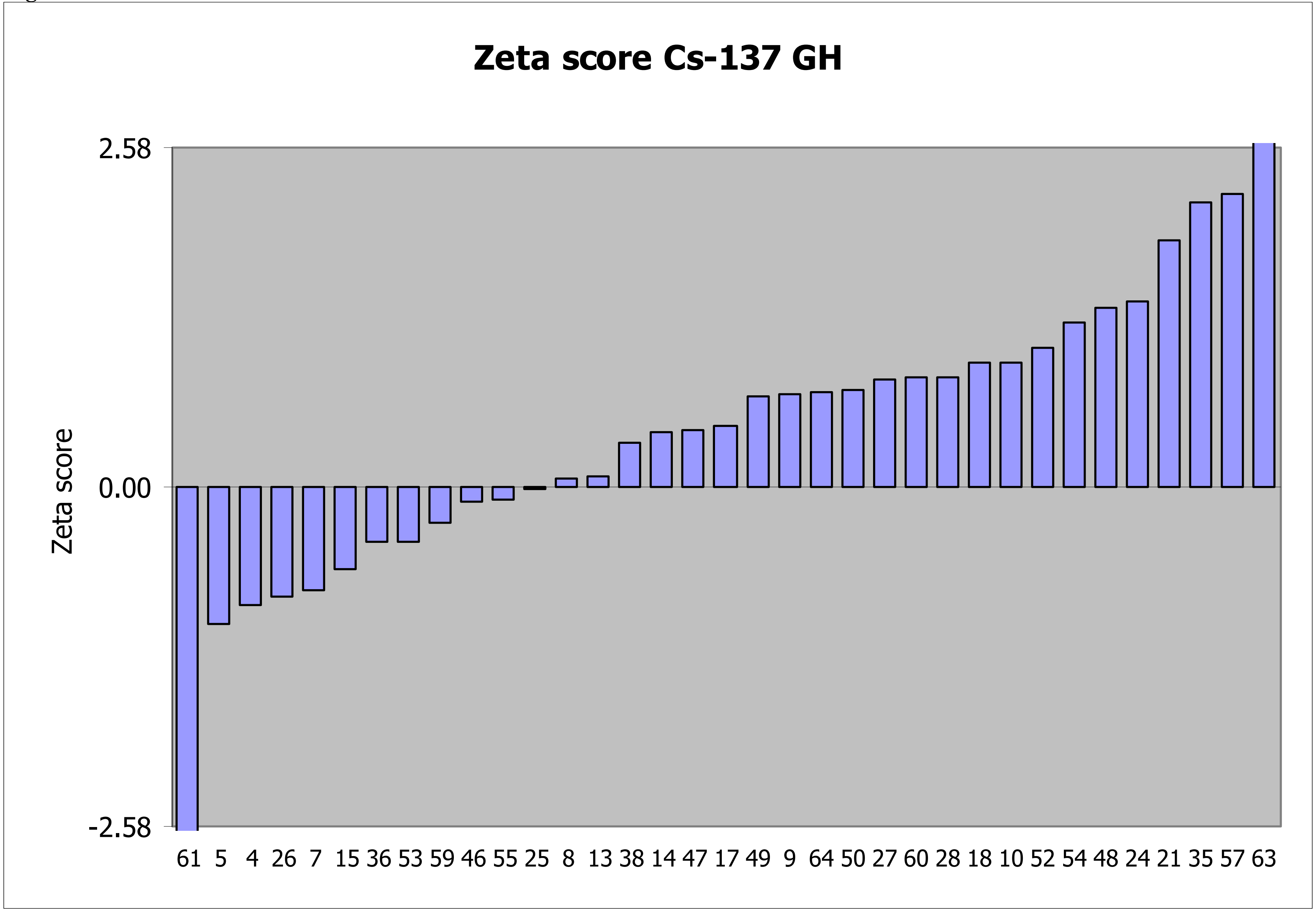


Figure 33C – Relative uncertainty Cs-137 GH

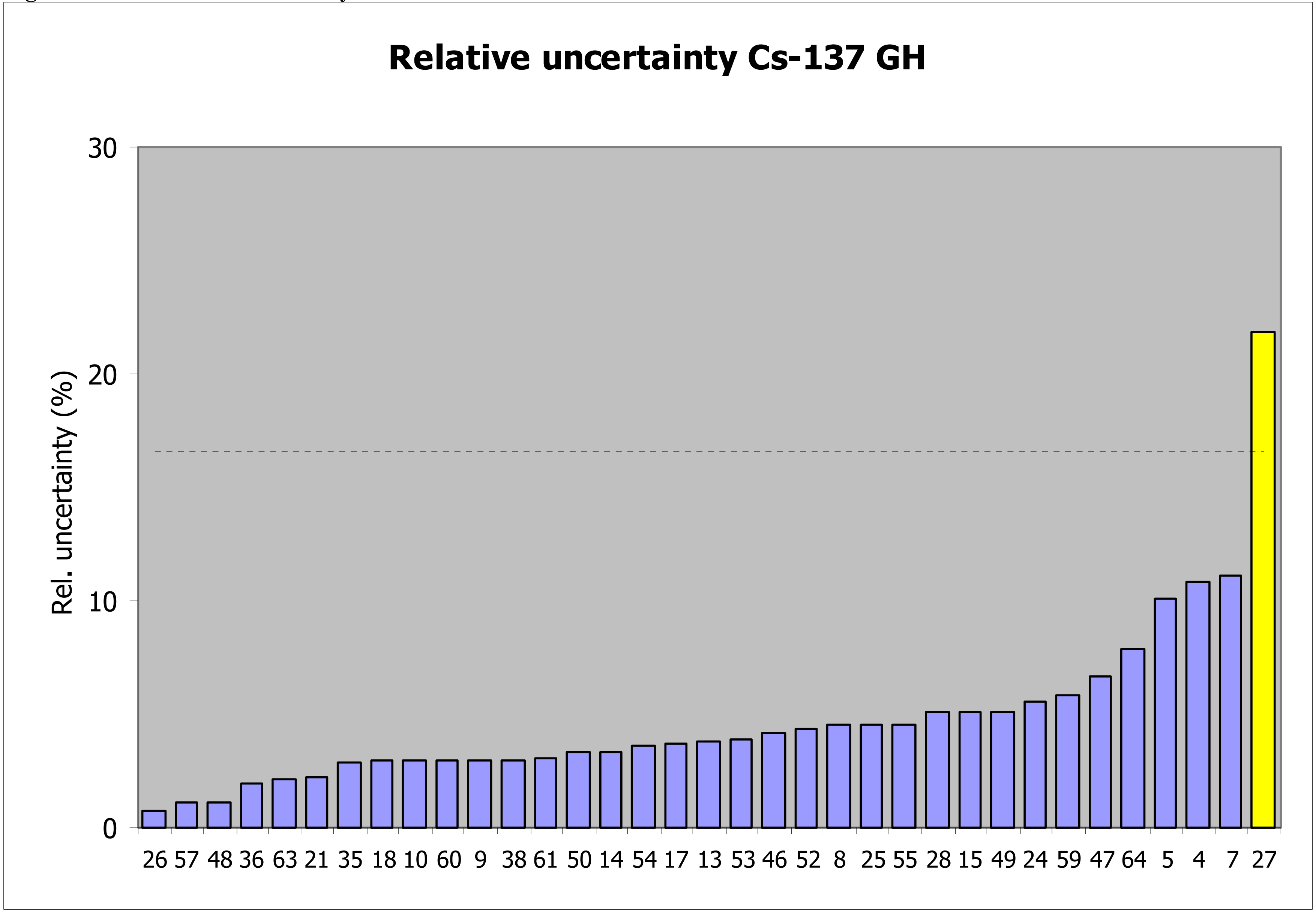


Figure 33D – Kiri plot Cs-137 GH

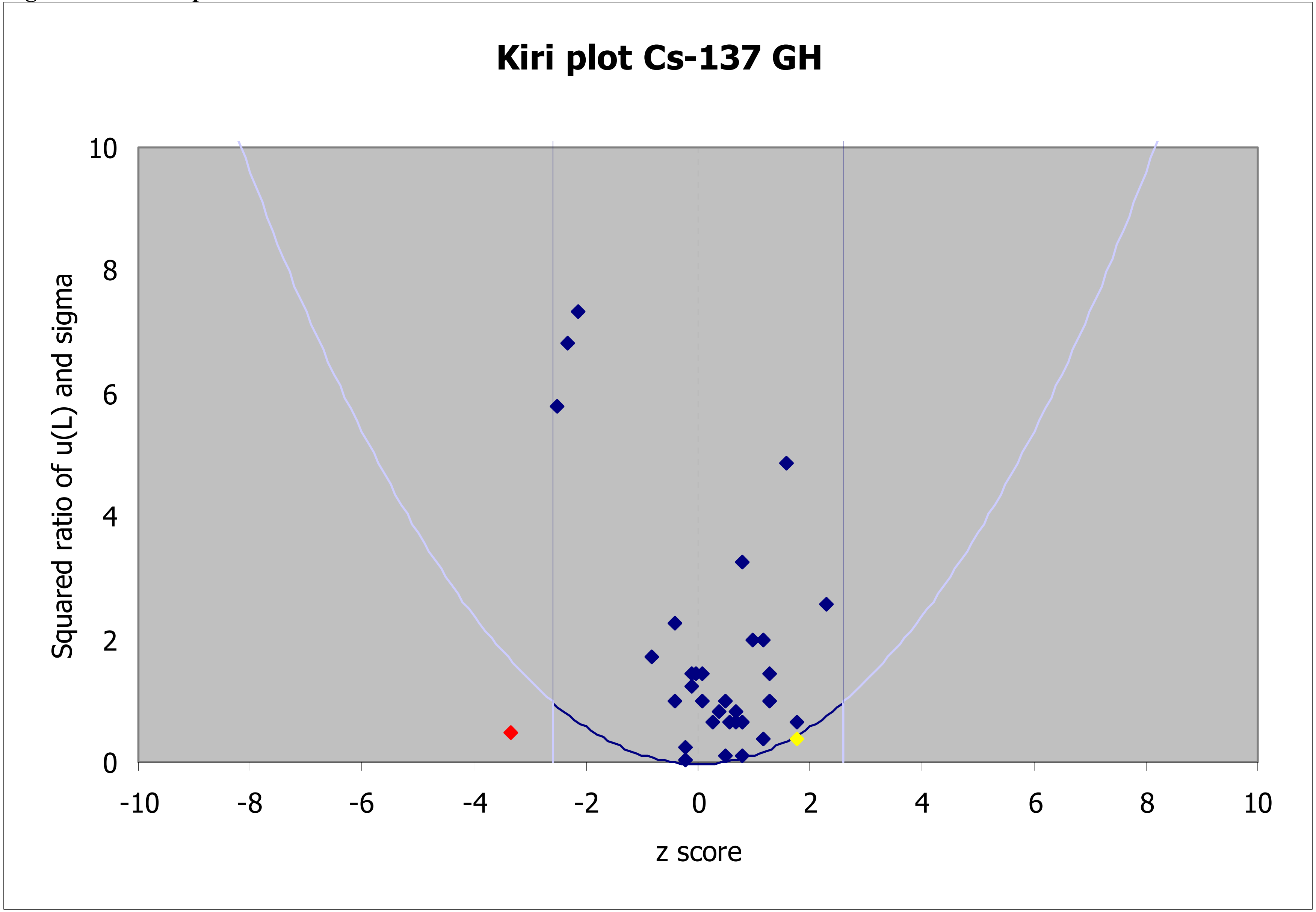


Figure 34A – Deviation Eu-152 GH

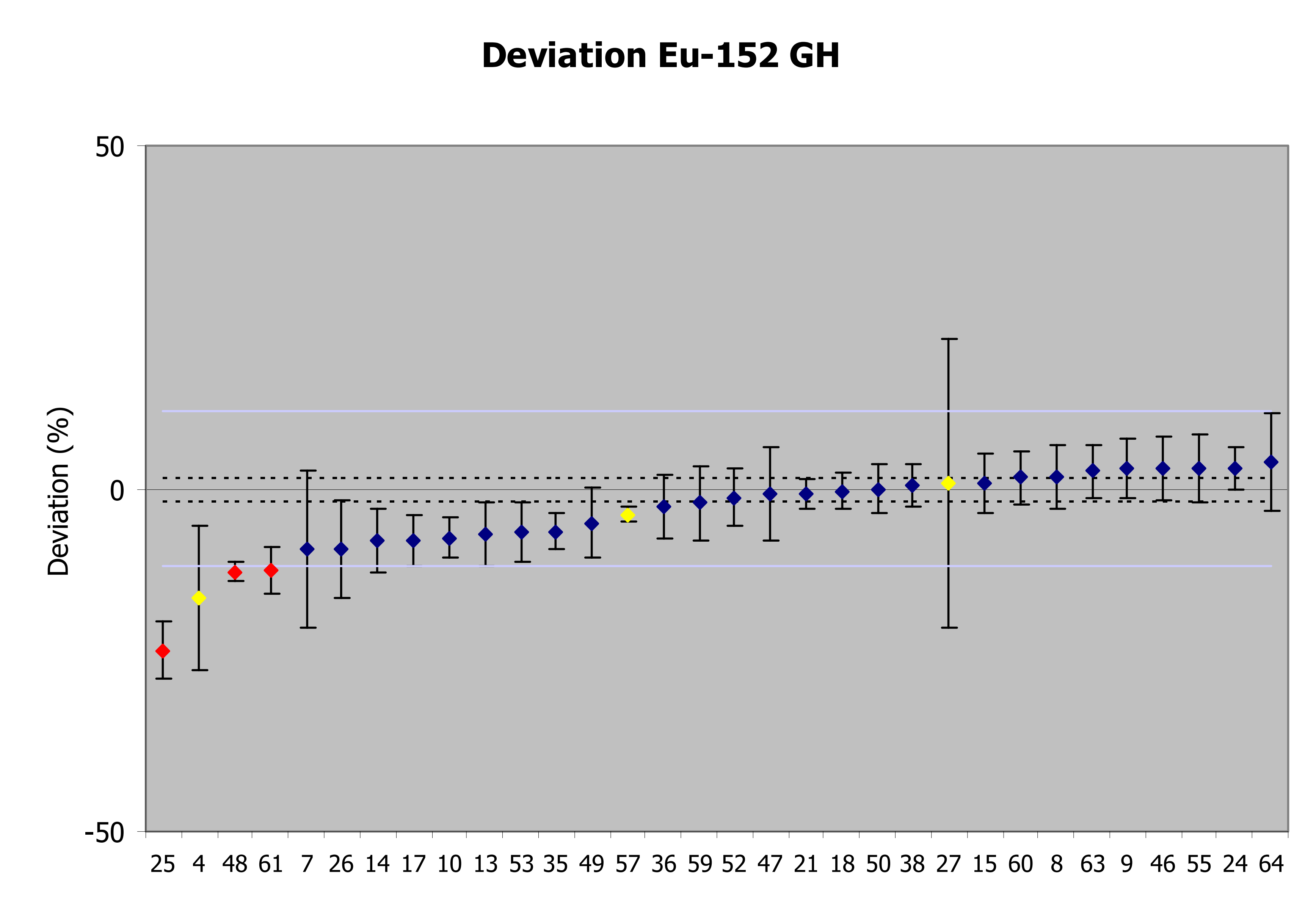


Figure 34B – Zeta score Eu-152 GH

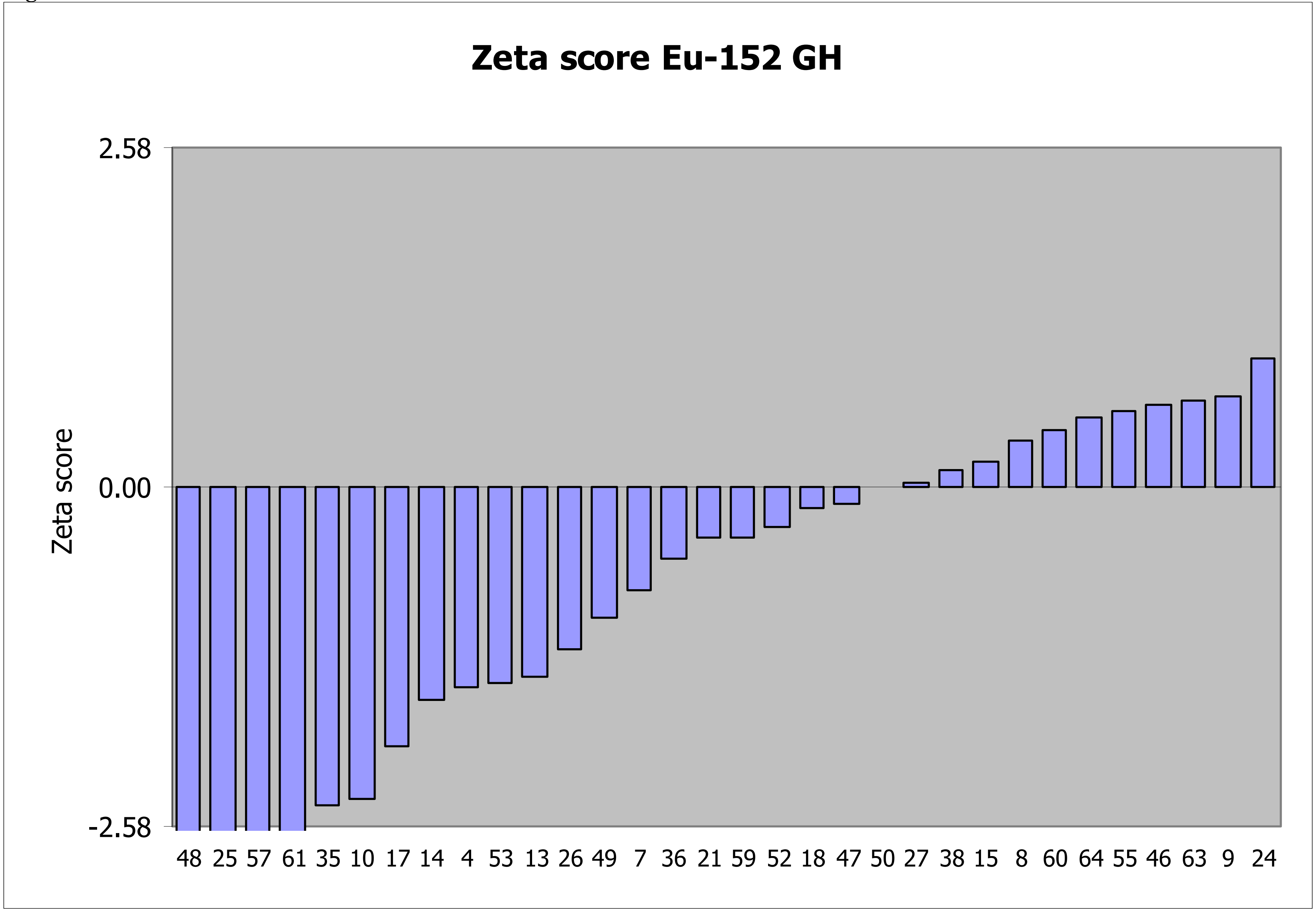


Figure 34C – Relative uncertainty Eu-152 GH

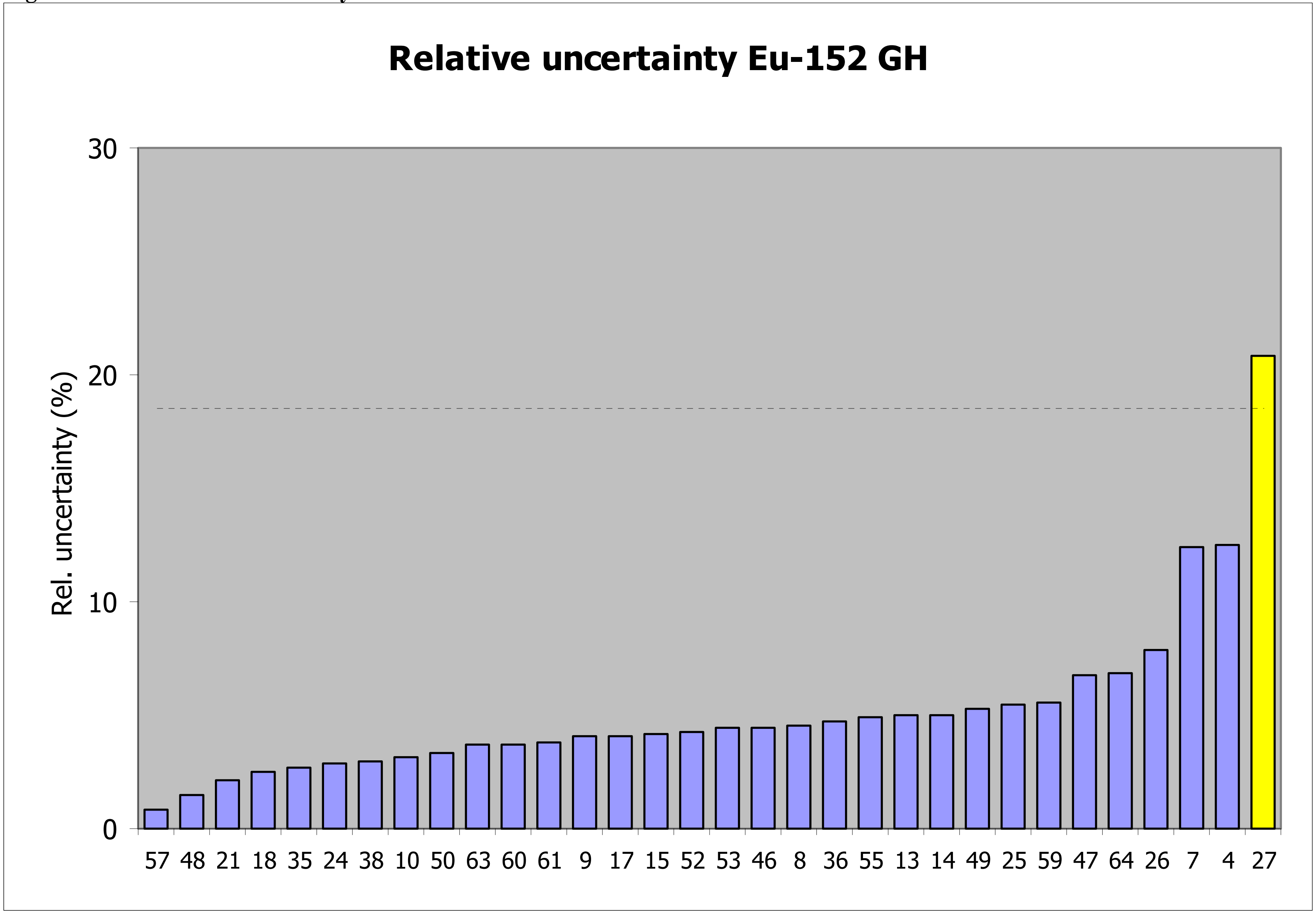


Figure 34D – Kiri plot Eu-152 GH

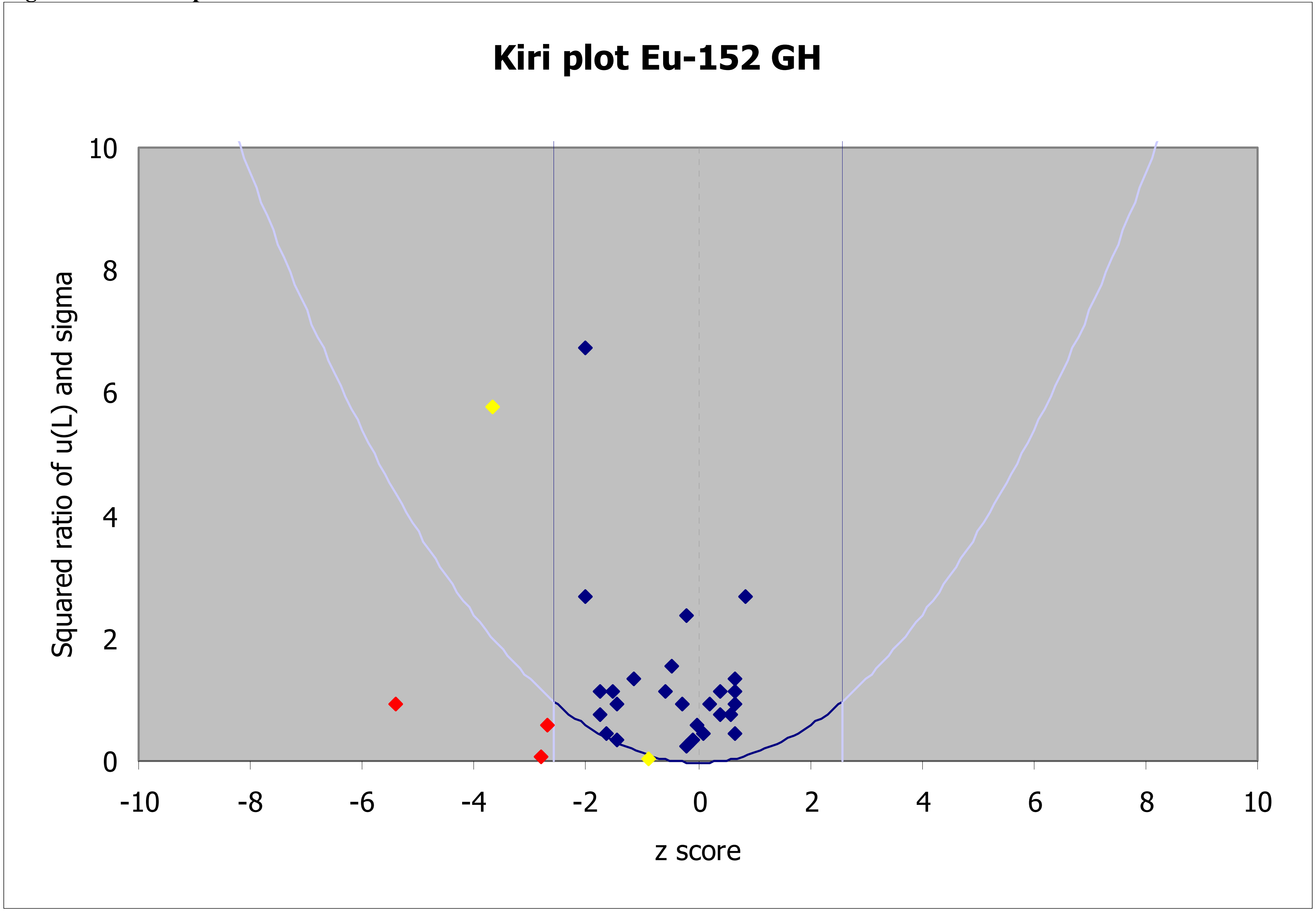


Figure 35A – Deviation H-3 LB

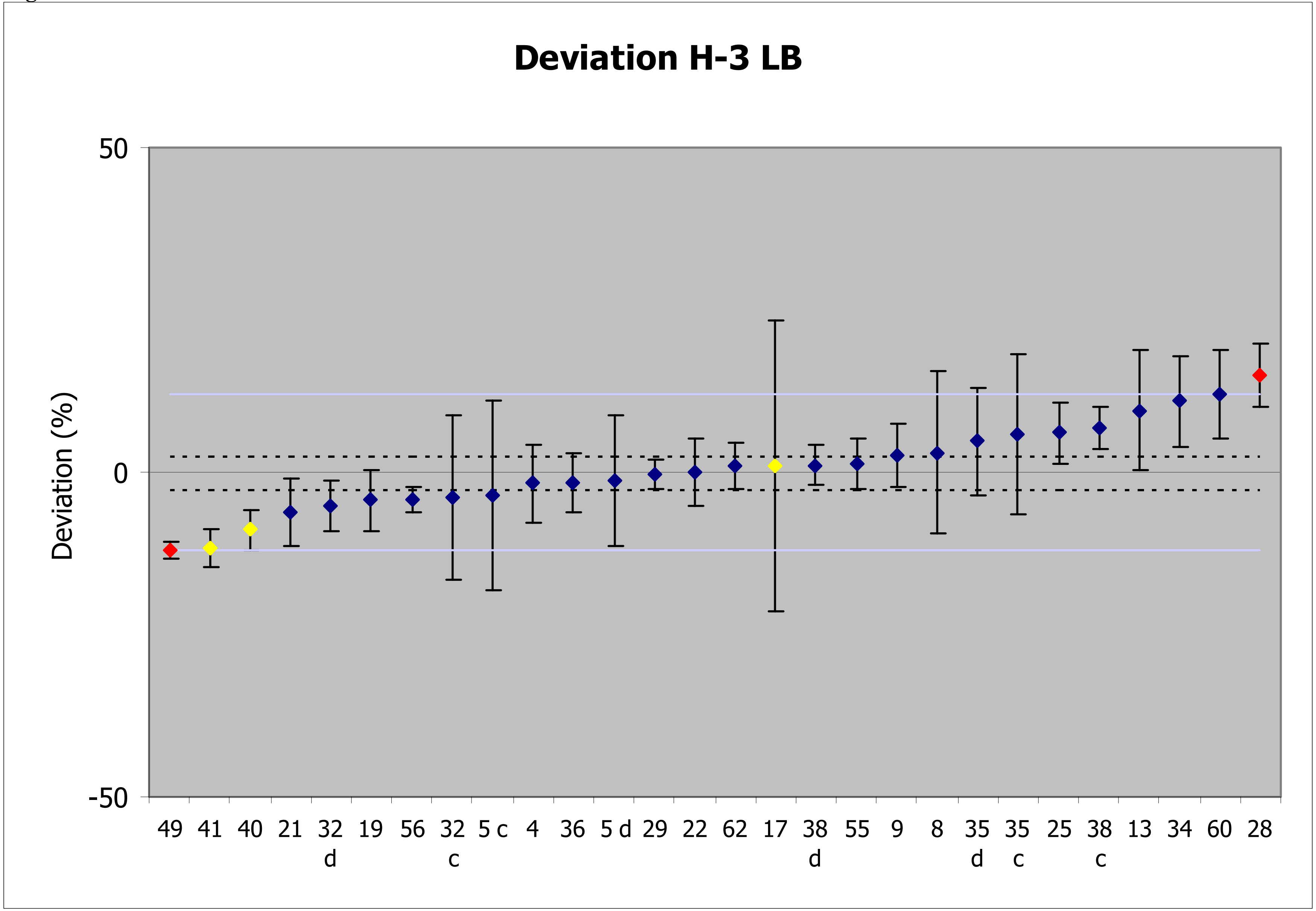


Figure 35B – Zeta score H-3 LB

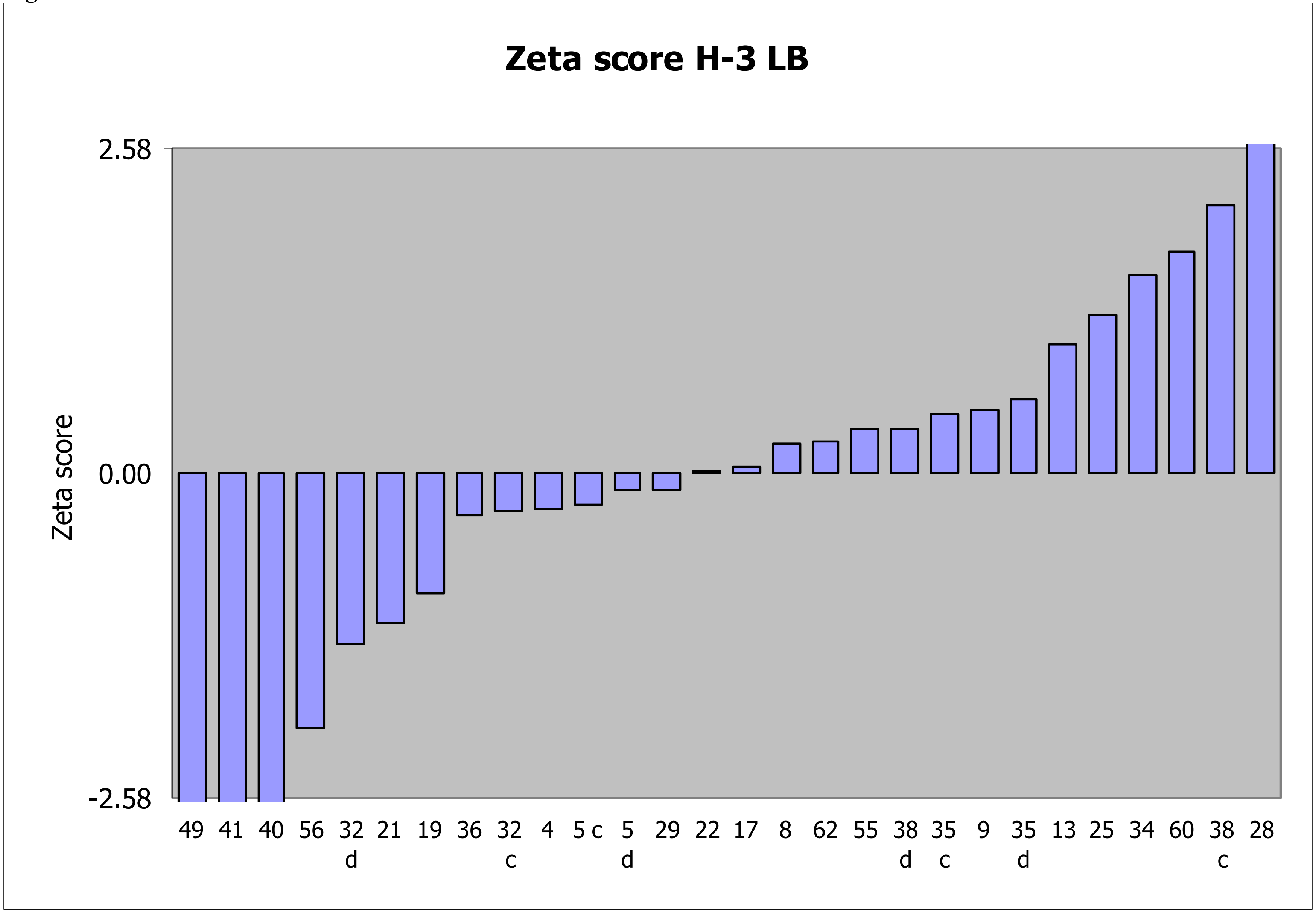


Figure 35C – Relative uncertainty H-3 LB

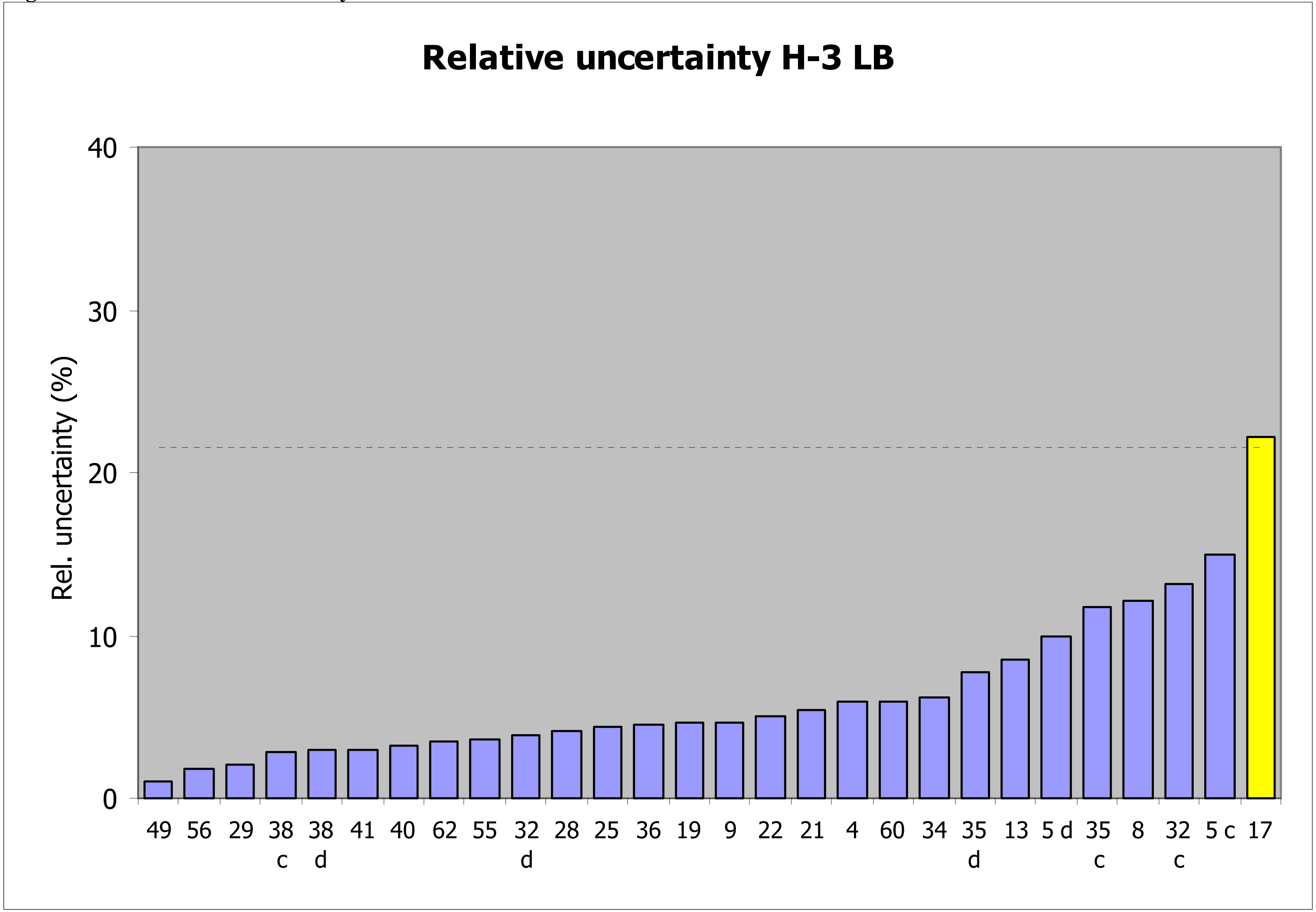


Figure 35D – Kiri plot H-3 LB

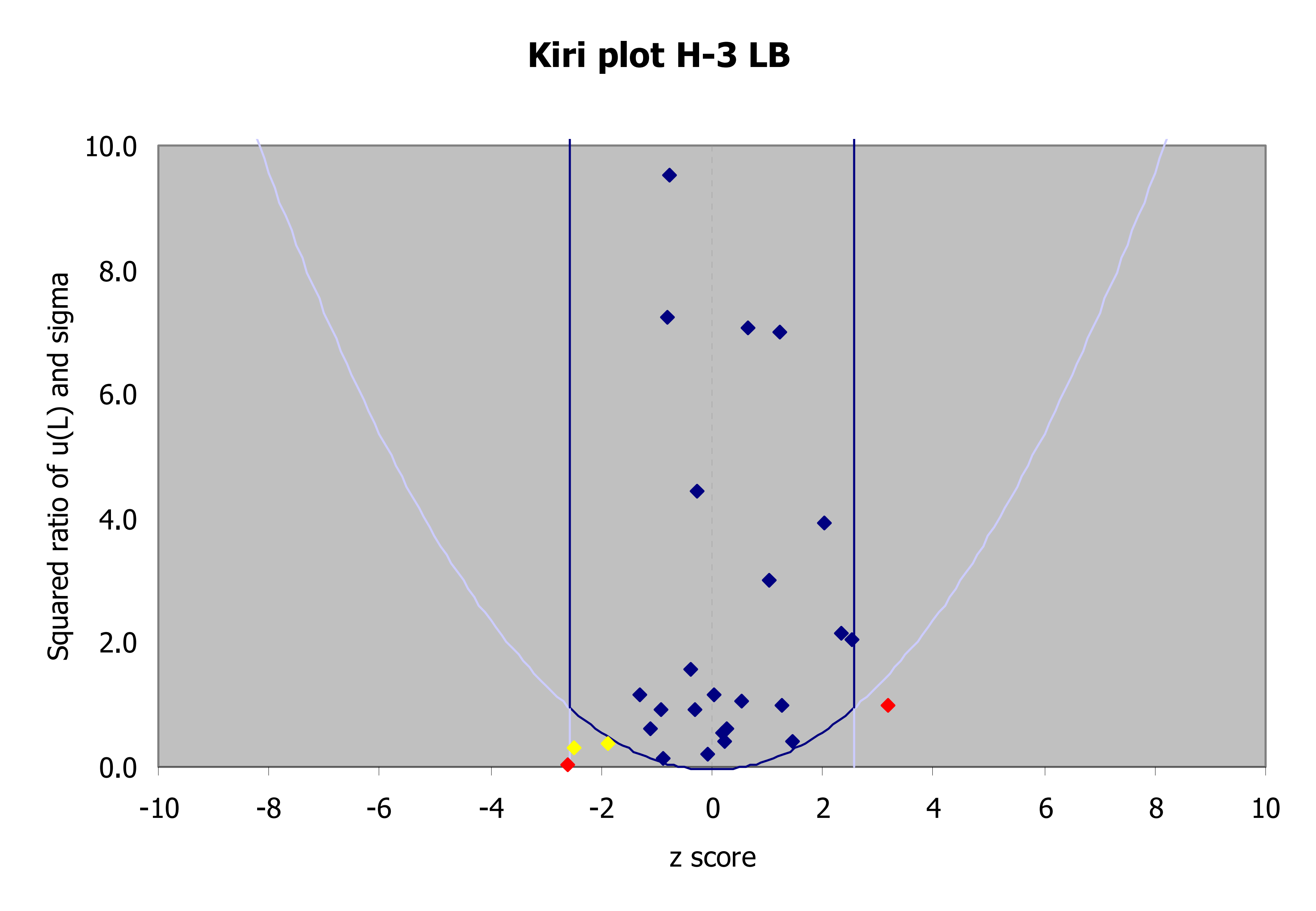


Figure 36A – Deviation C-14 LB

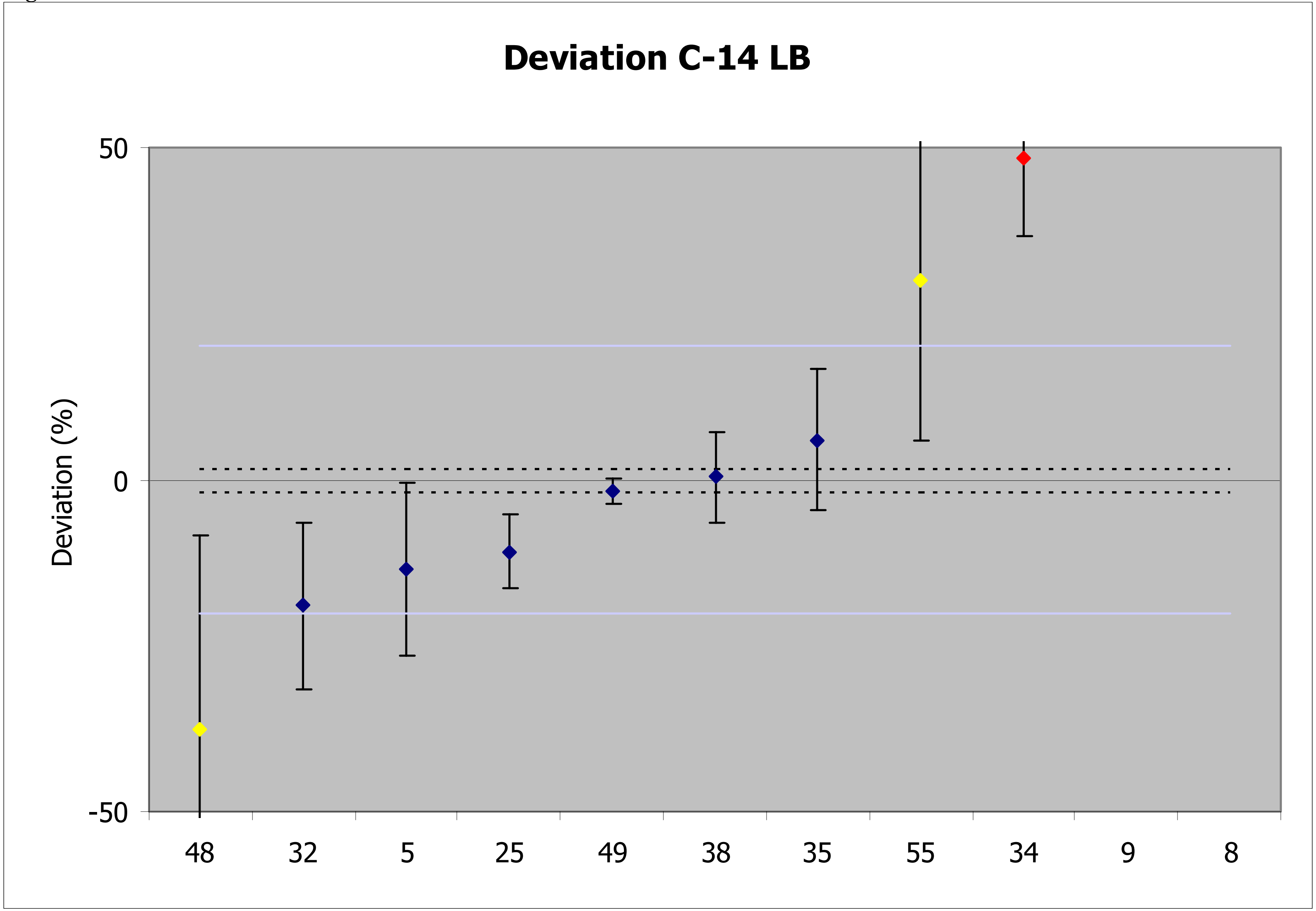


Figure 36B – Zeta score C-14 LB

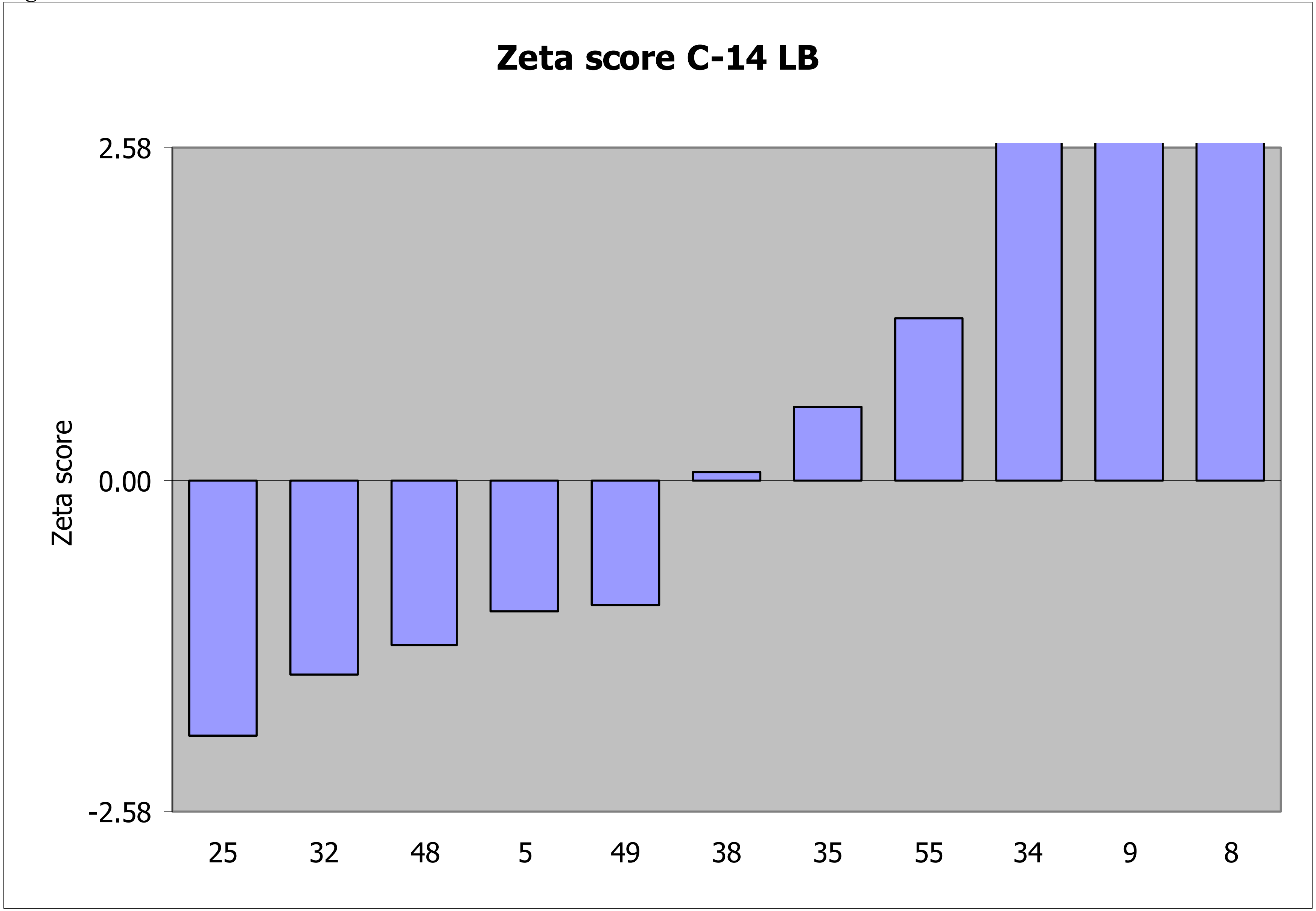


Figure 36C – Relative uncertainty C-14 LB

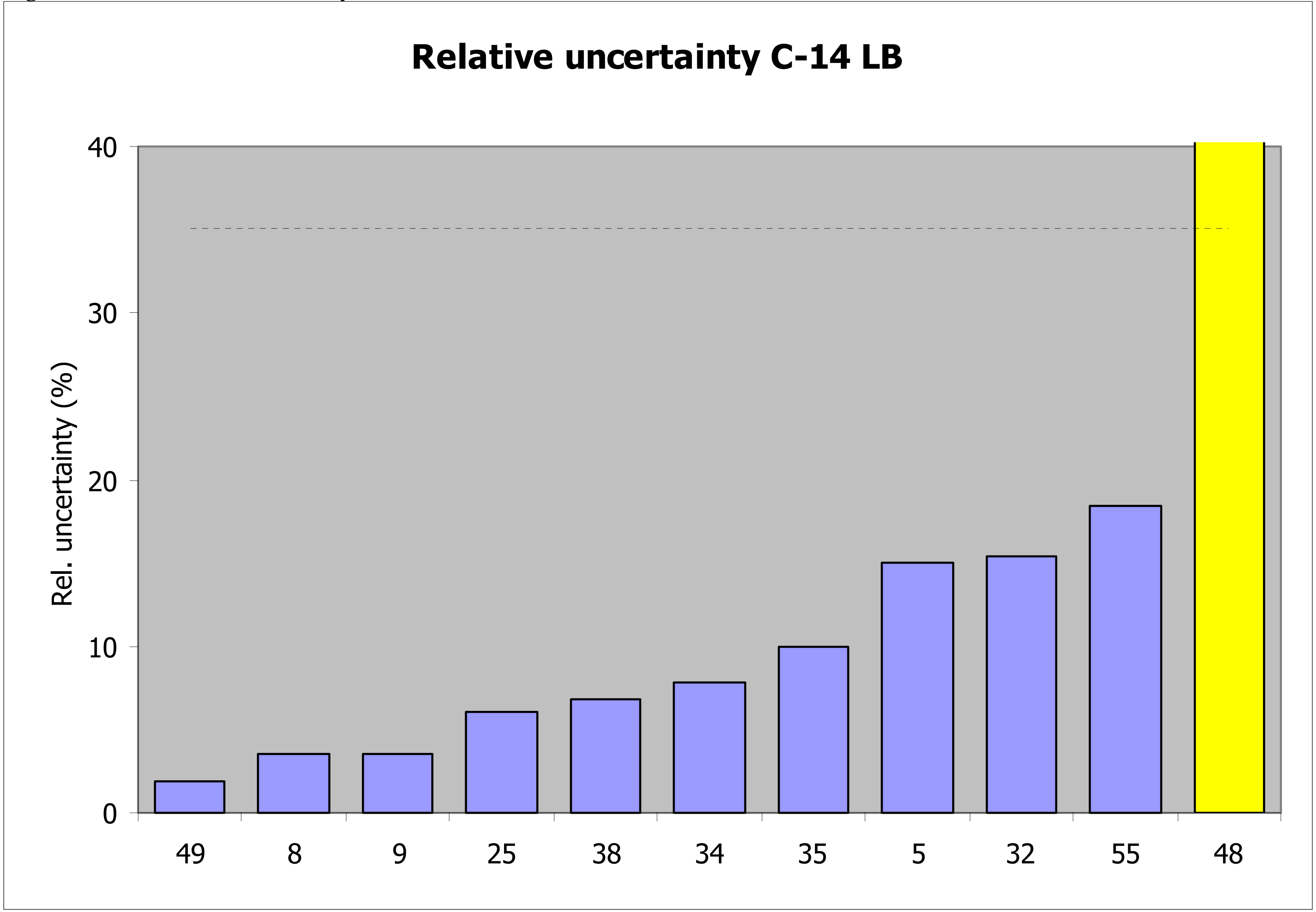


Figure 36D – Kiri plot C-14 LB

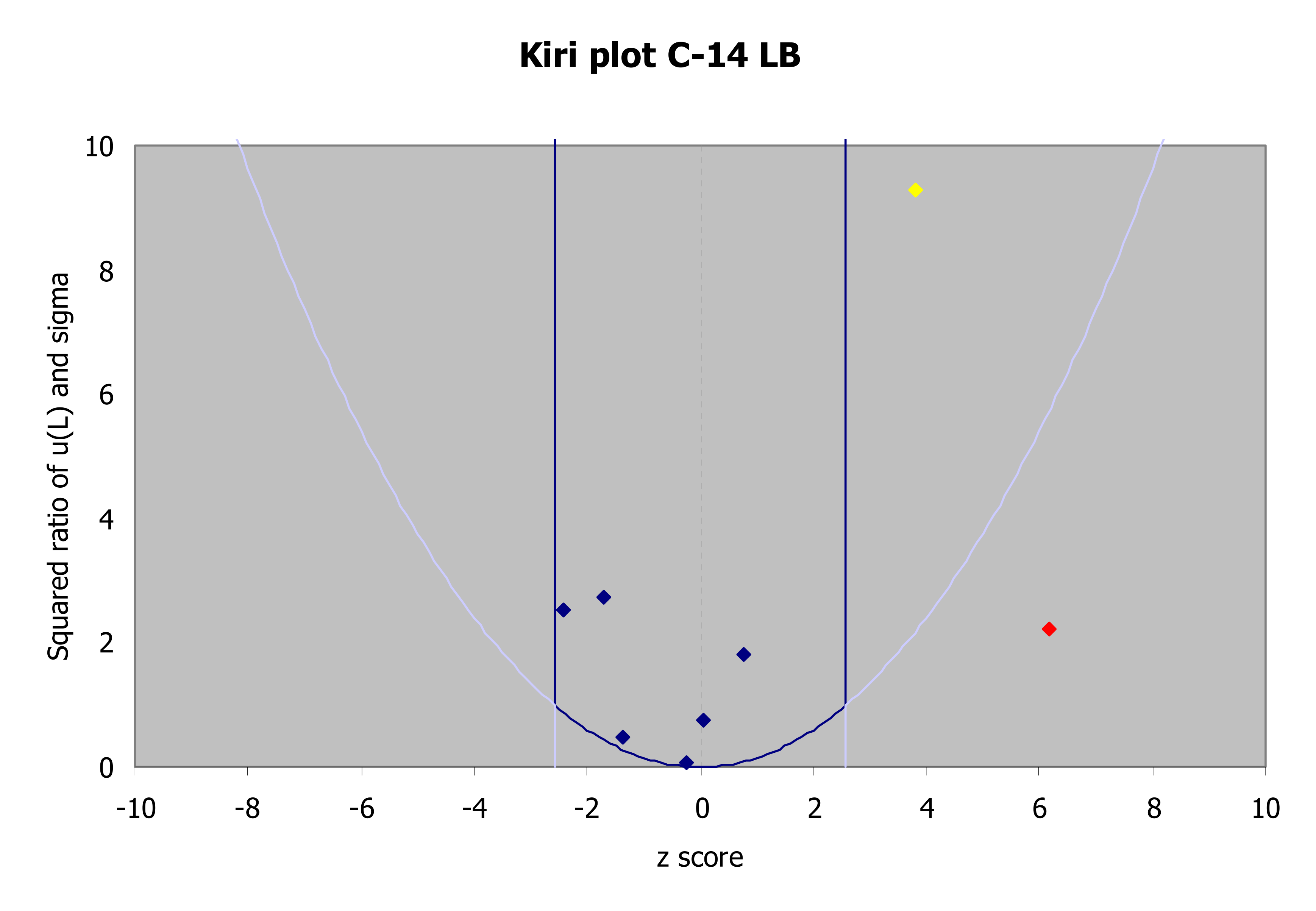


Figure 37A – Deviation S-35 LB

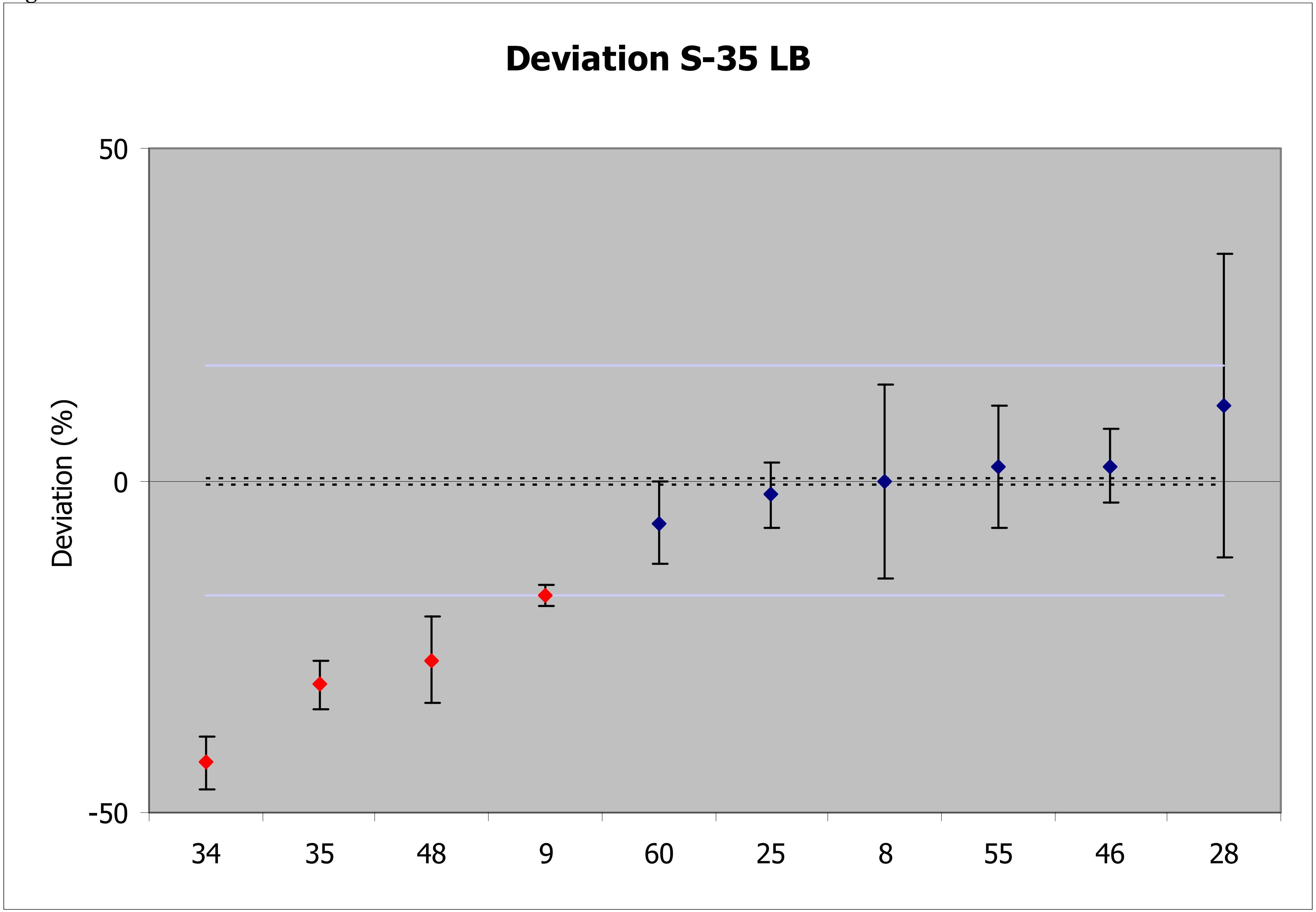


Figure 37B – Zeta score S-35 LB

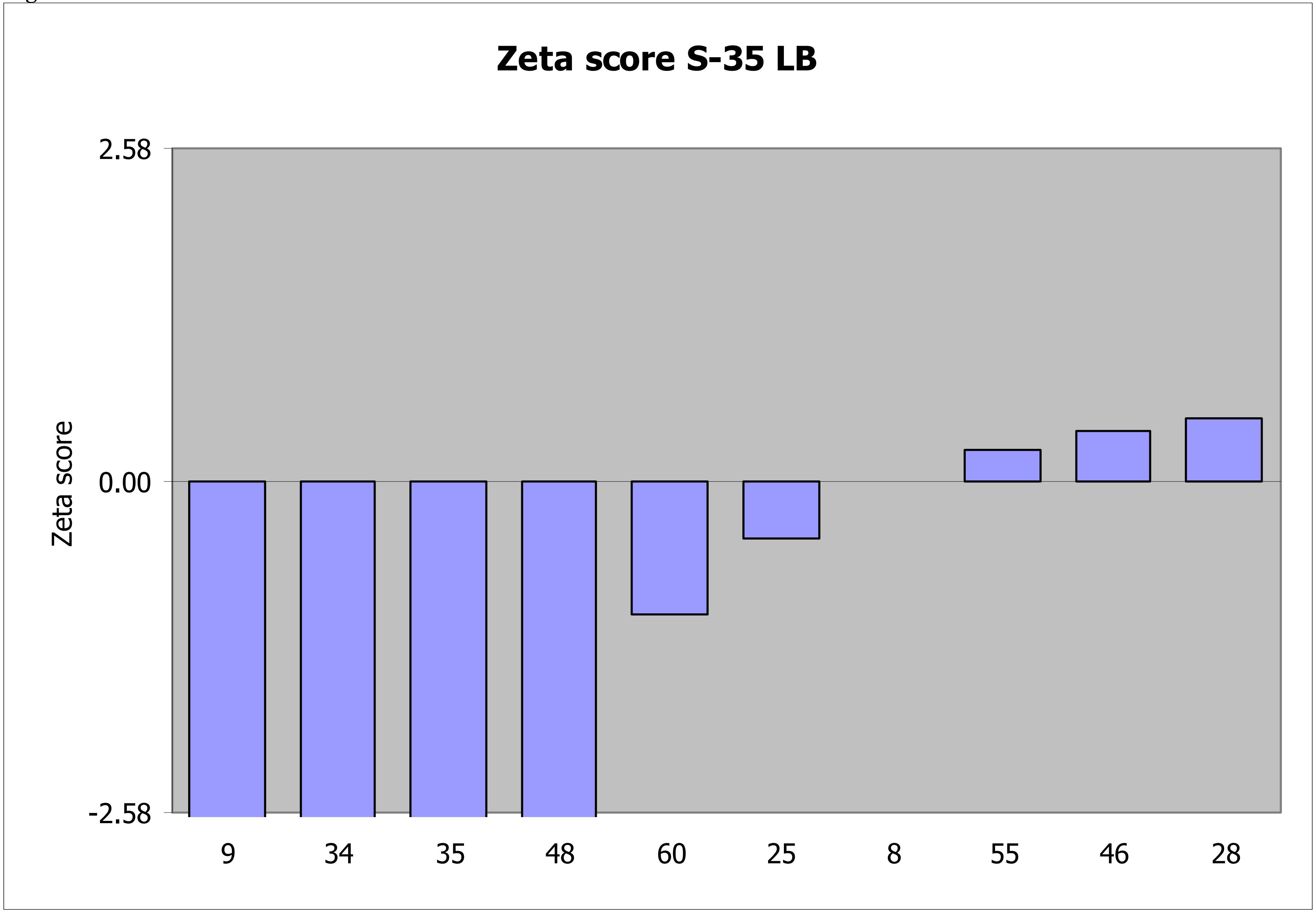


Figure 37C – Relative uncertainty S-35 LB

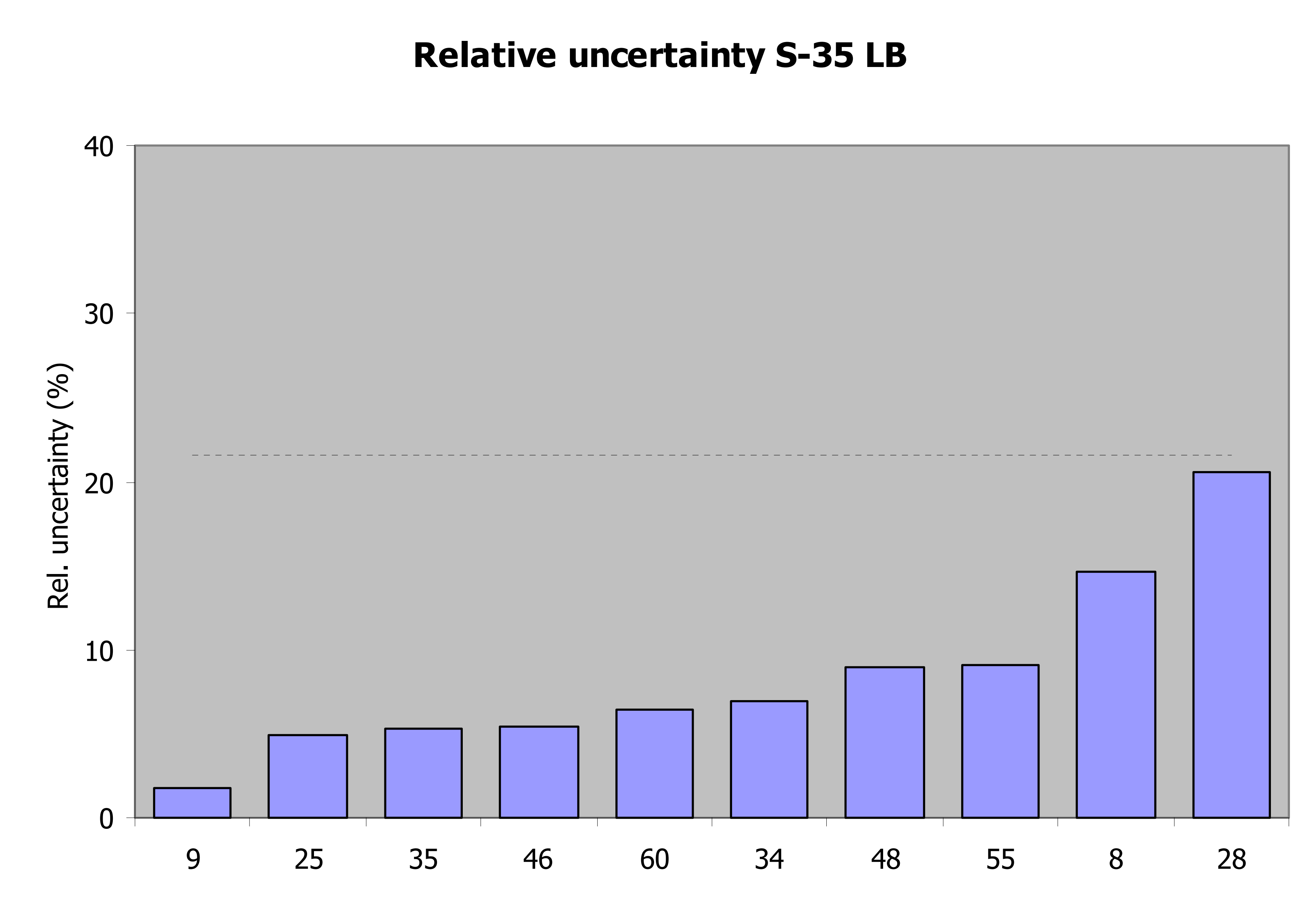


Figure 37D – Kiri plot S-35 LB

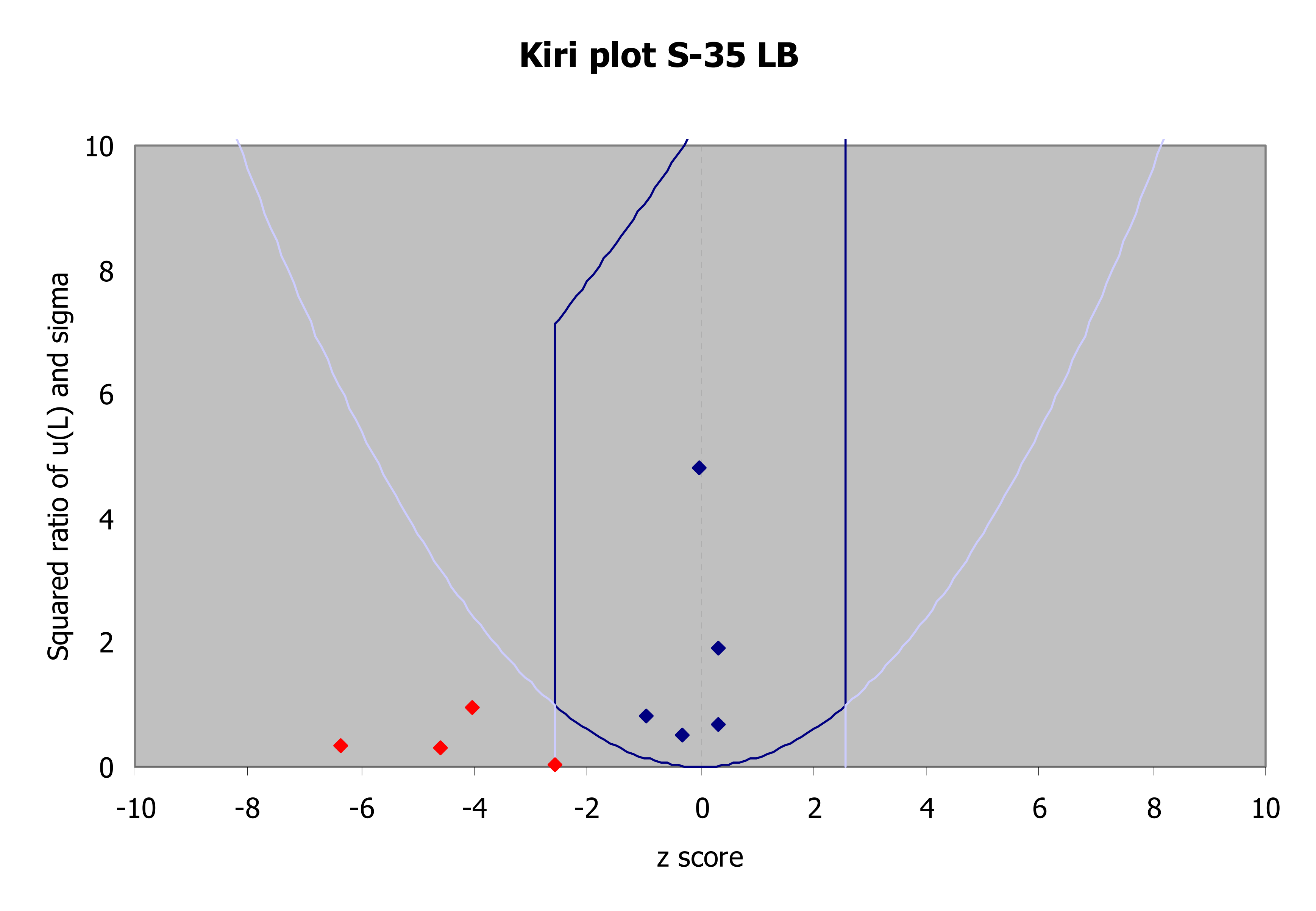


Figure 38 – Unweighted means of the deviations

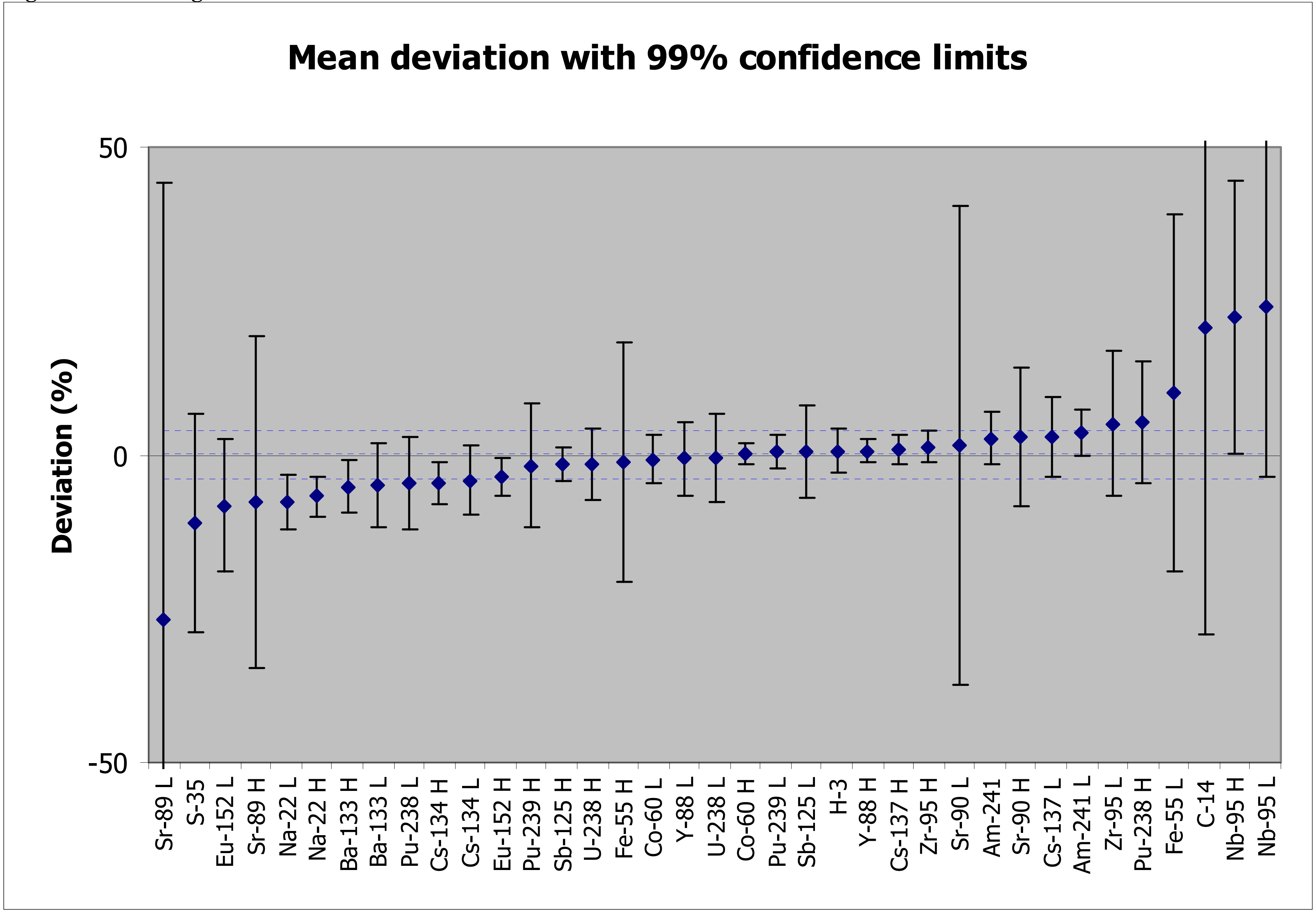


Figure 39 – Medians of the deviation

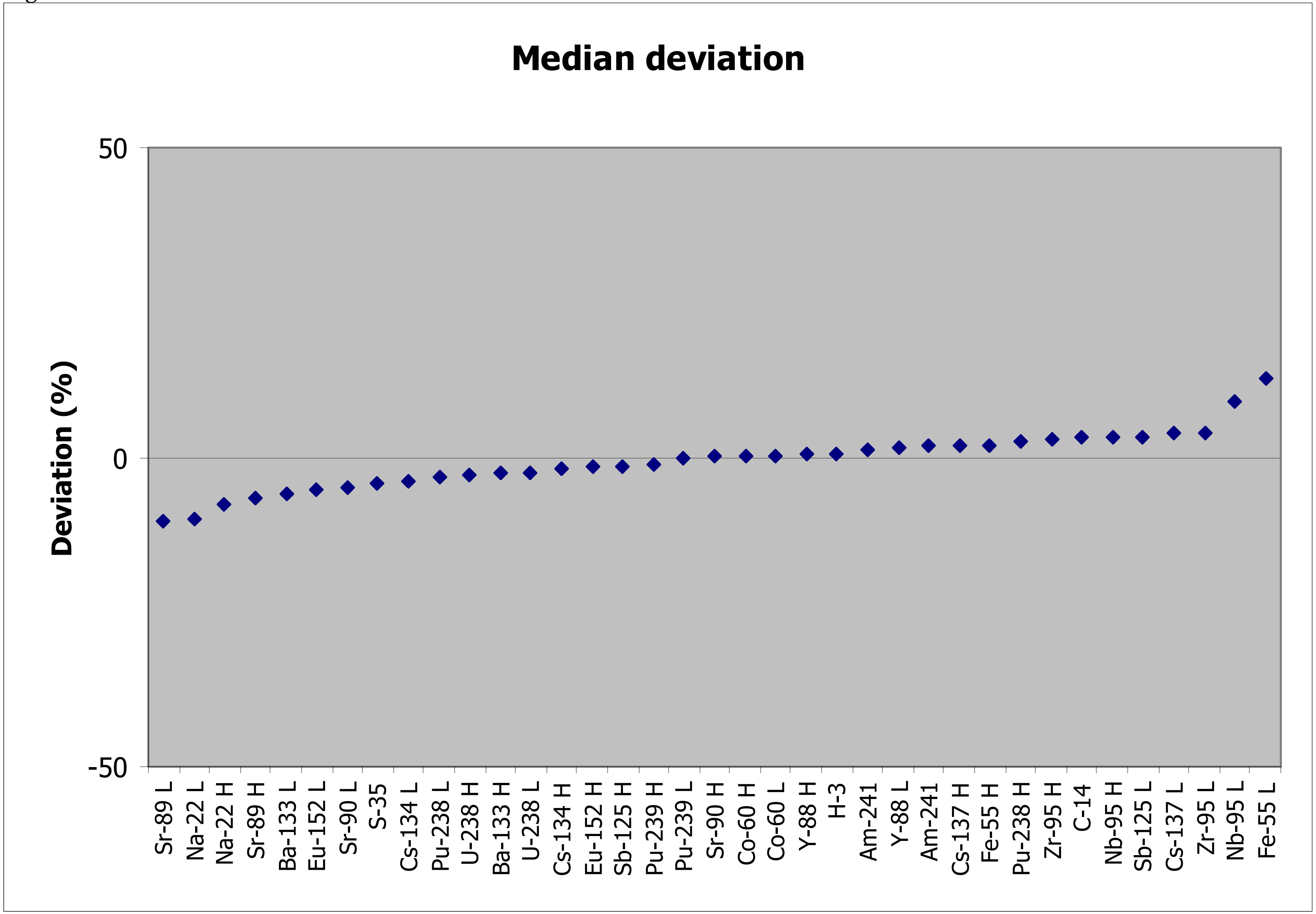


Figure 40 – Median and outlier limits of the relative uncertainty for the laboratory values

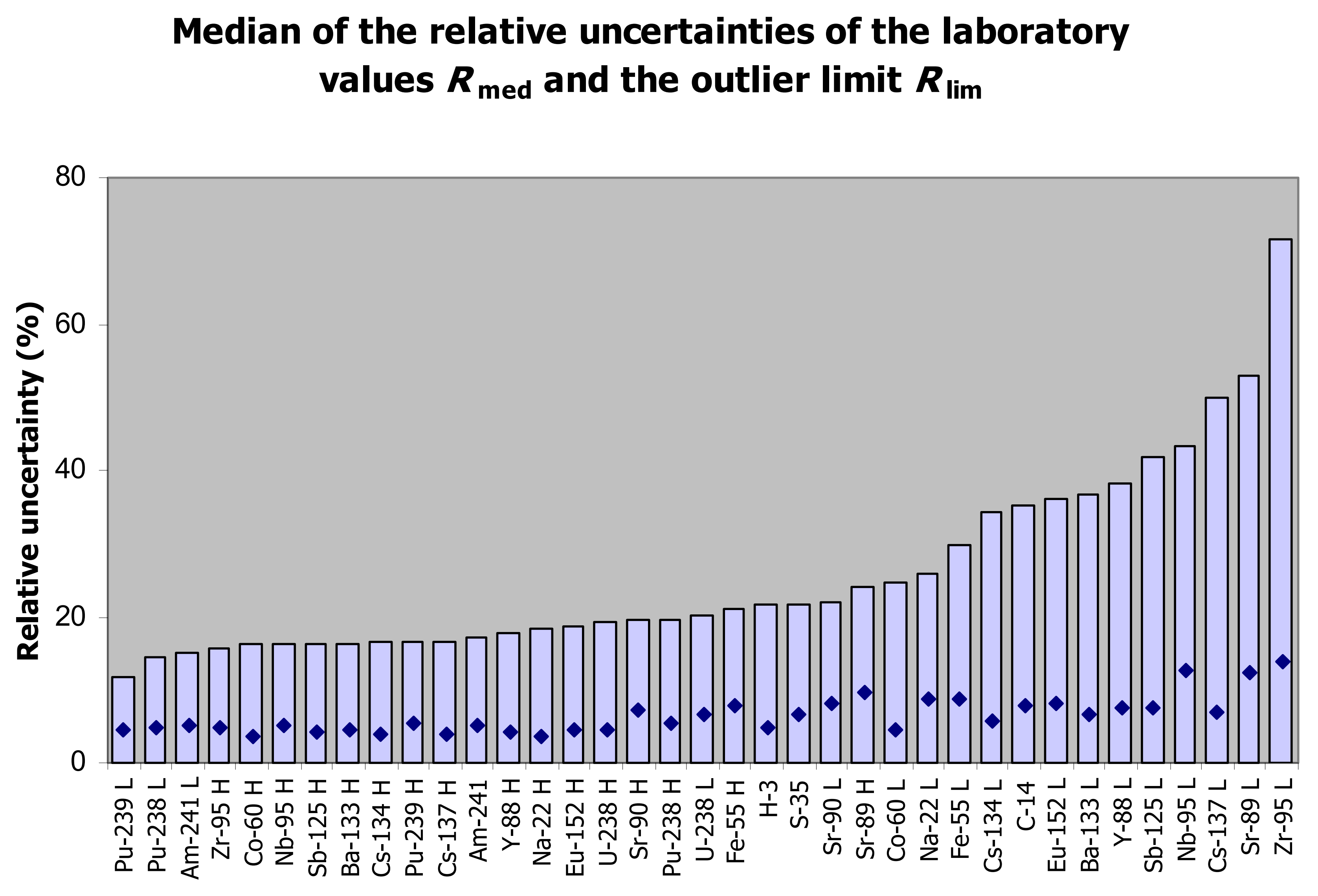


Figure 41 – Laboratory 4

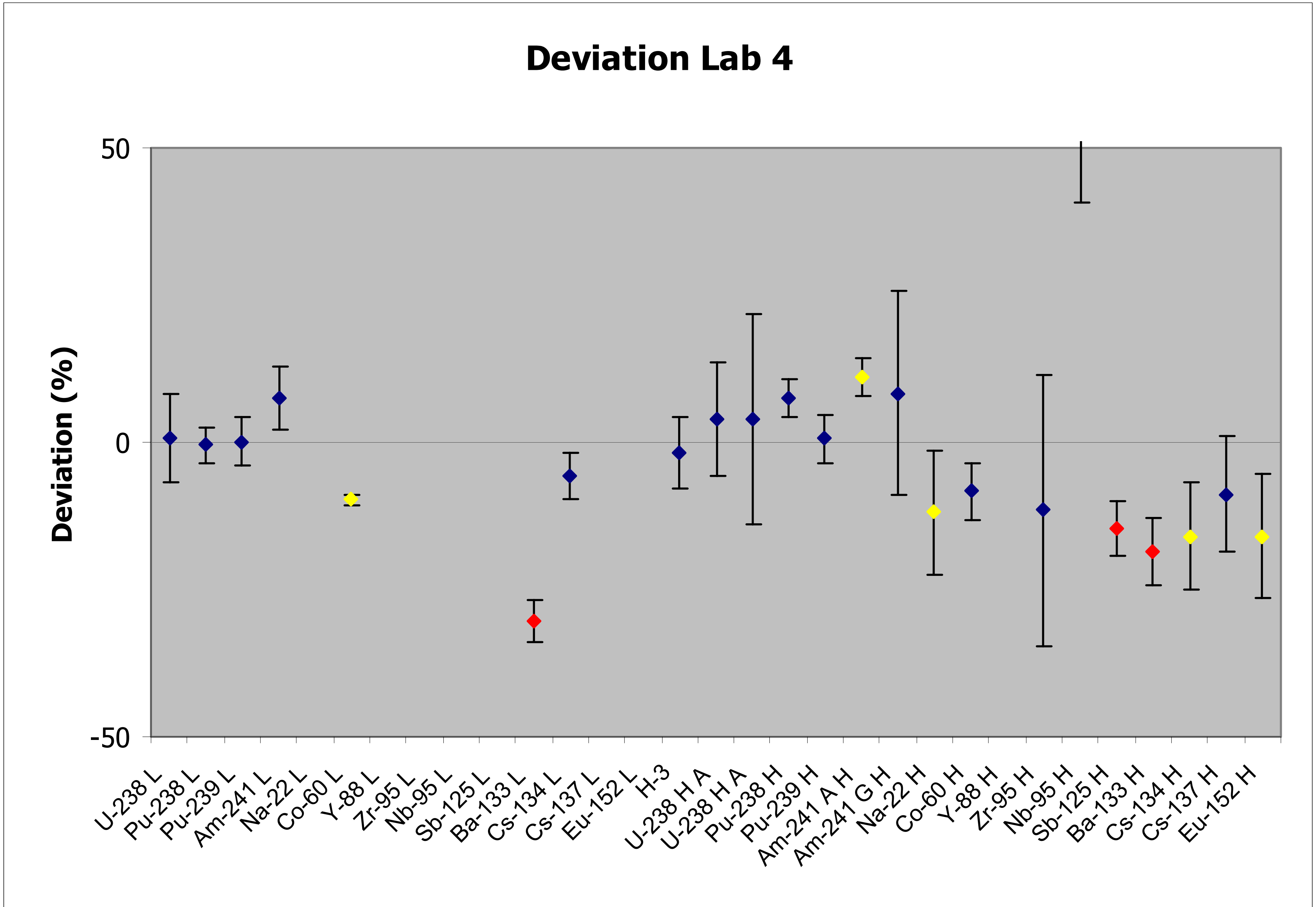


Figure 42 – Laboratory 5

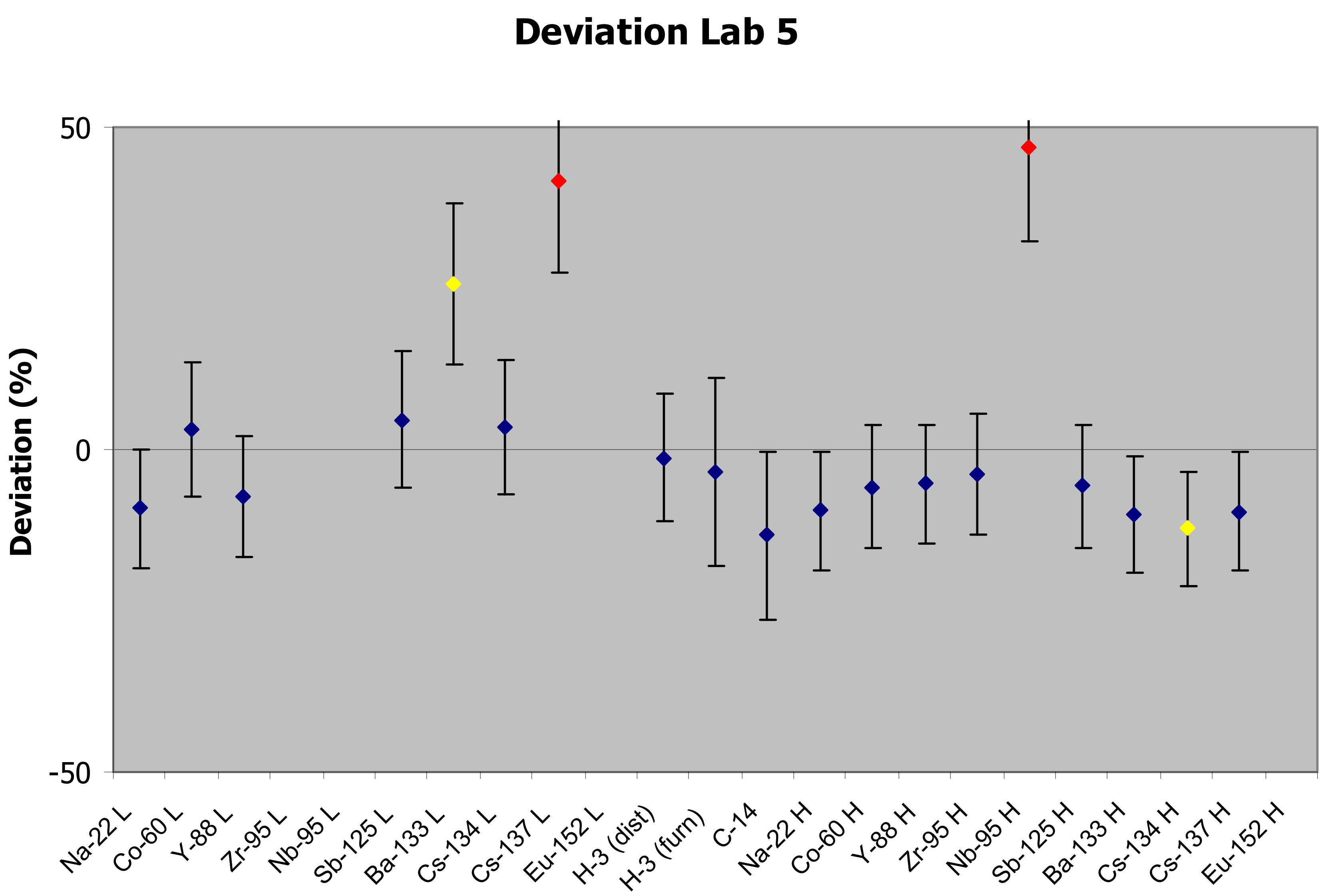


Figure 43 – Laboratory 7

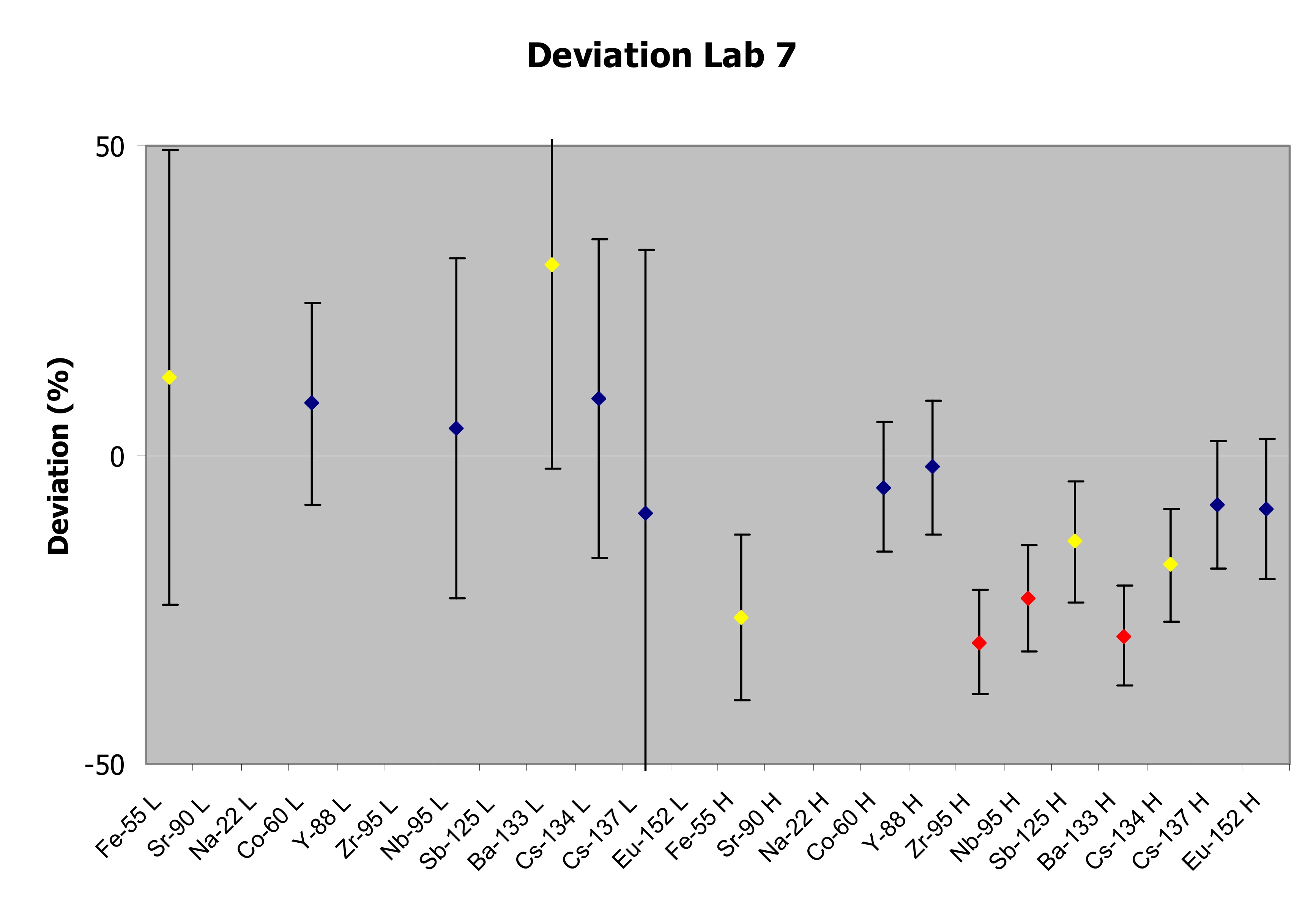


Figure 44 – Laboratory 8

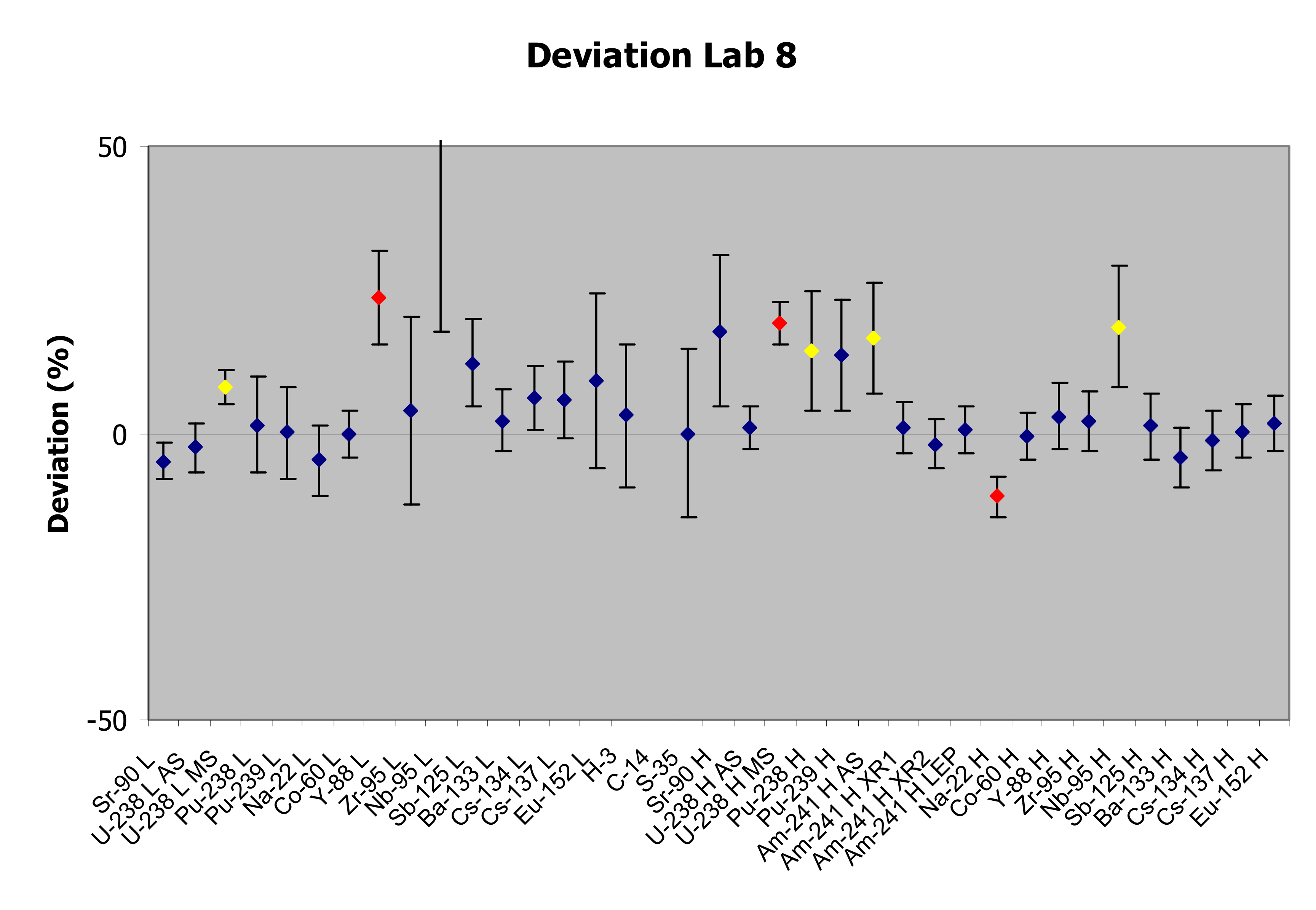


Figure 45 – Laboratory 9

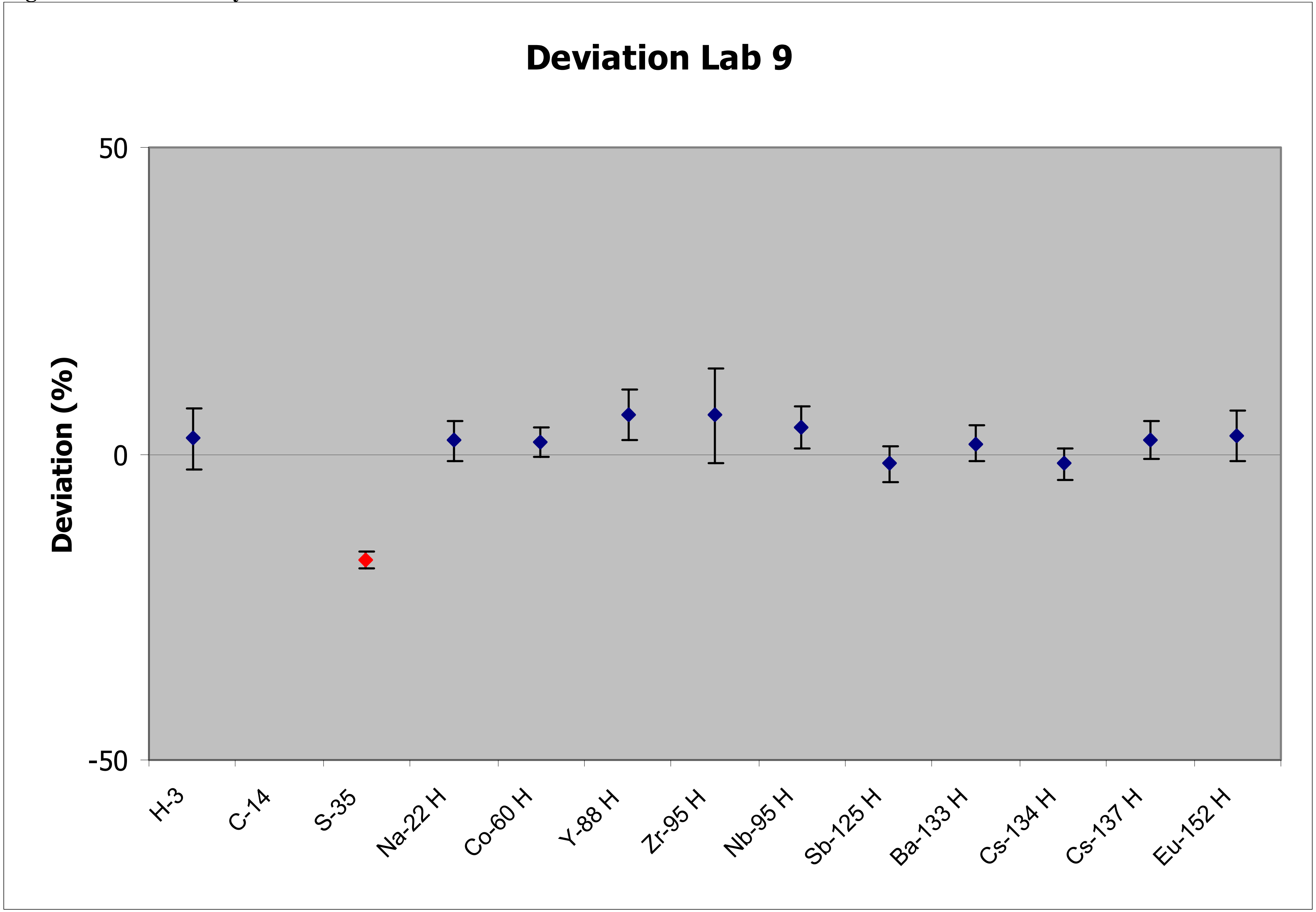


Figure 46 – Laboratory 10

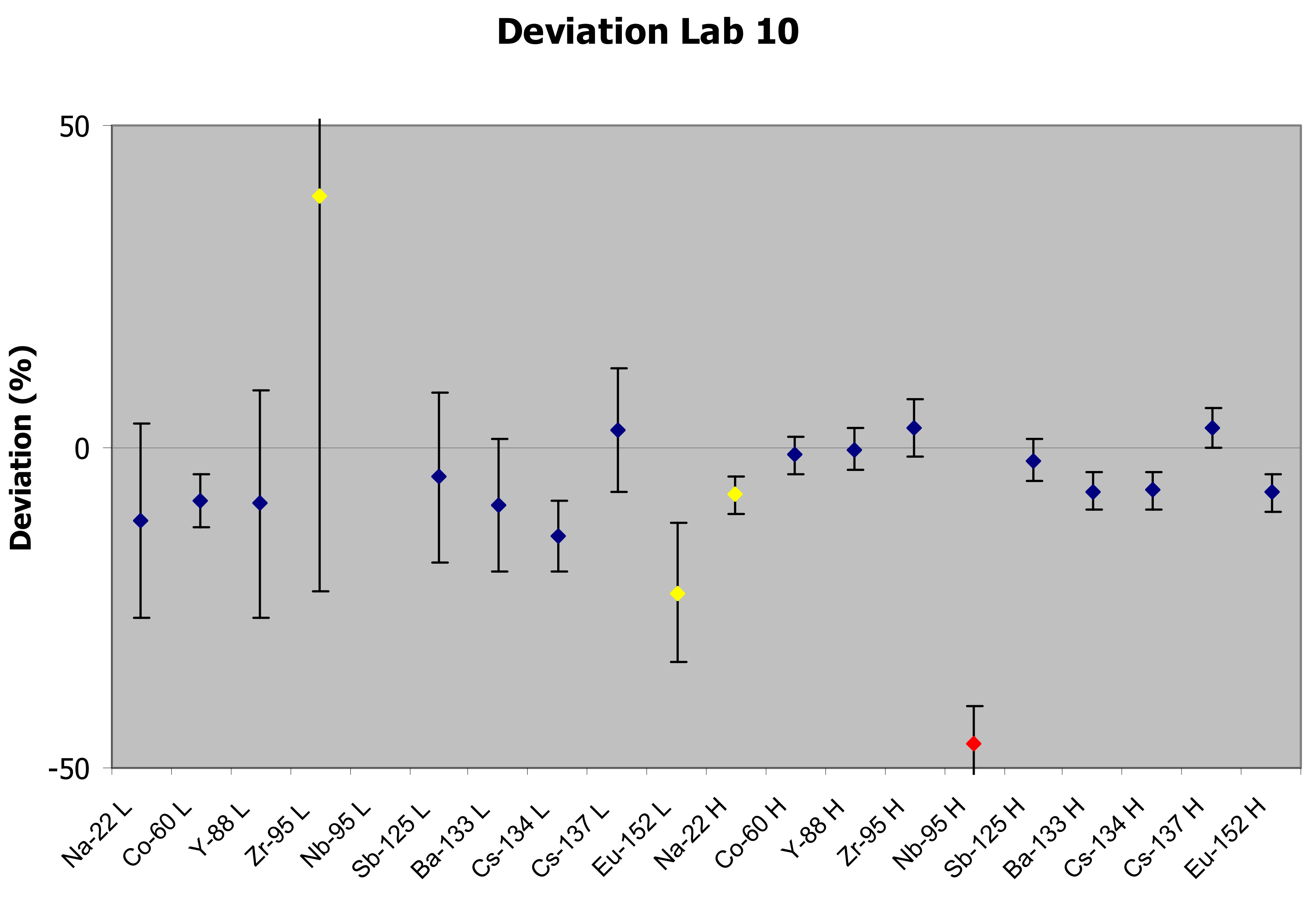


Figure 47 – Laboratory 13

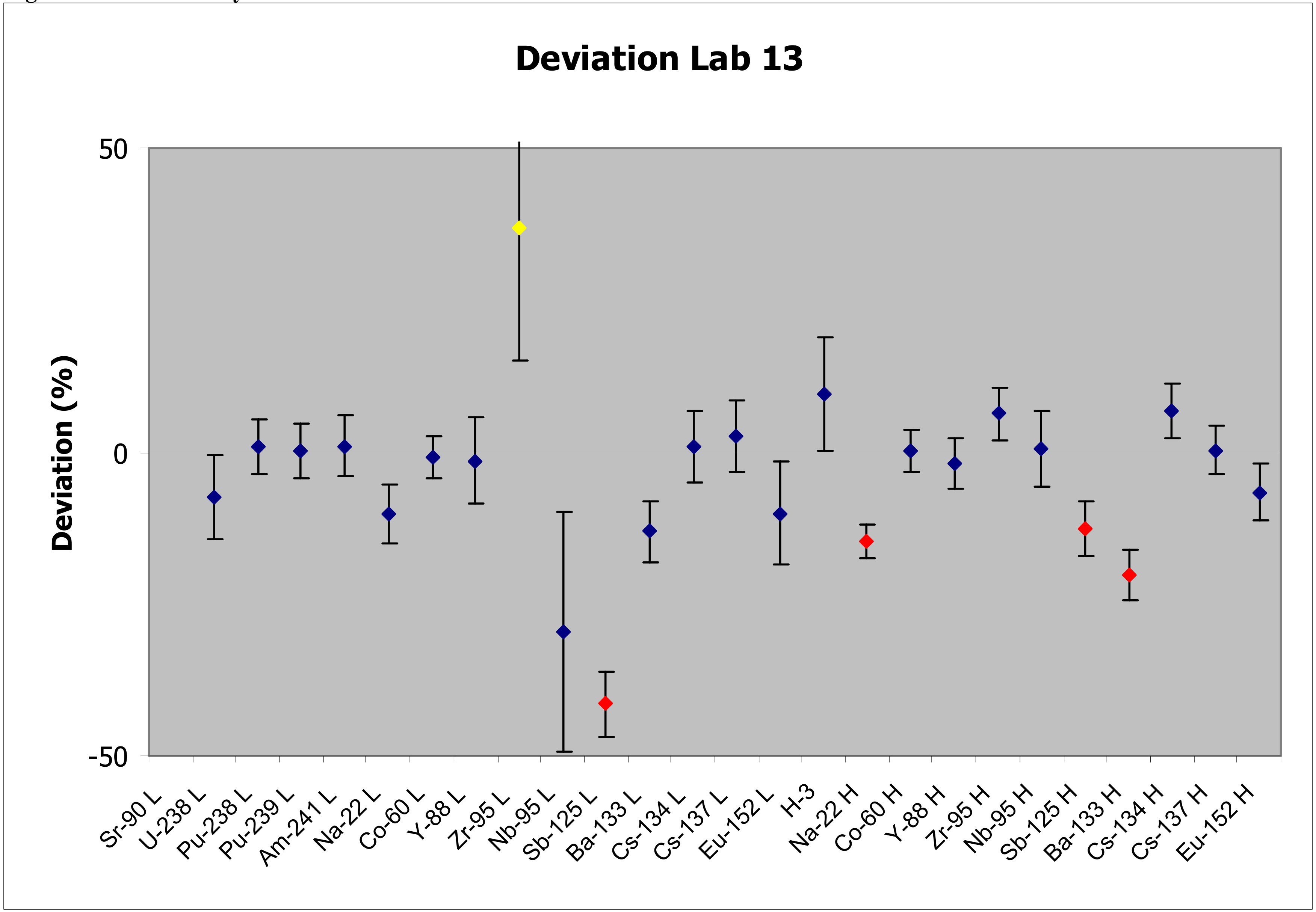


Figure 48 – Laboratory 14

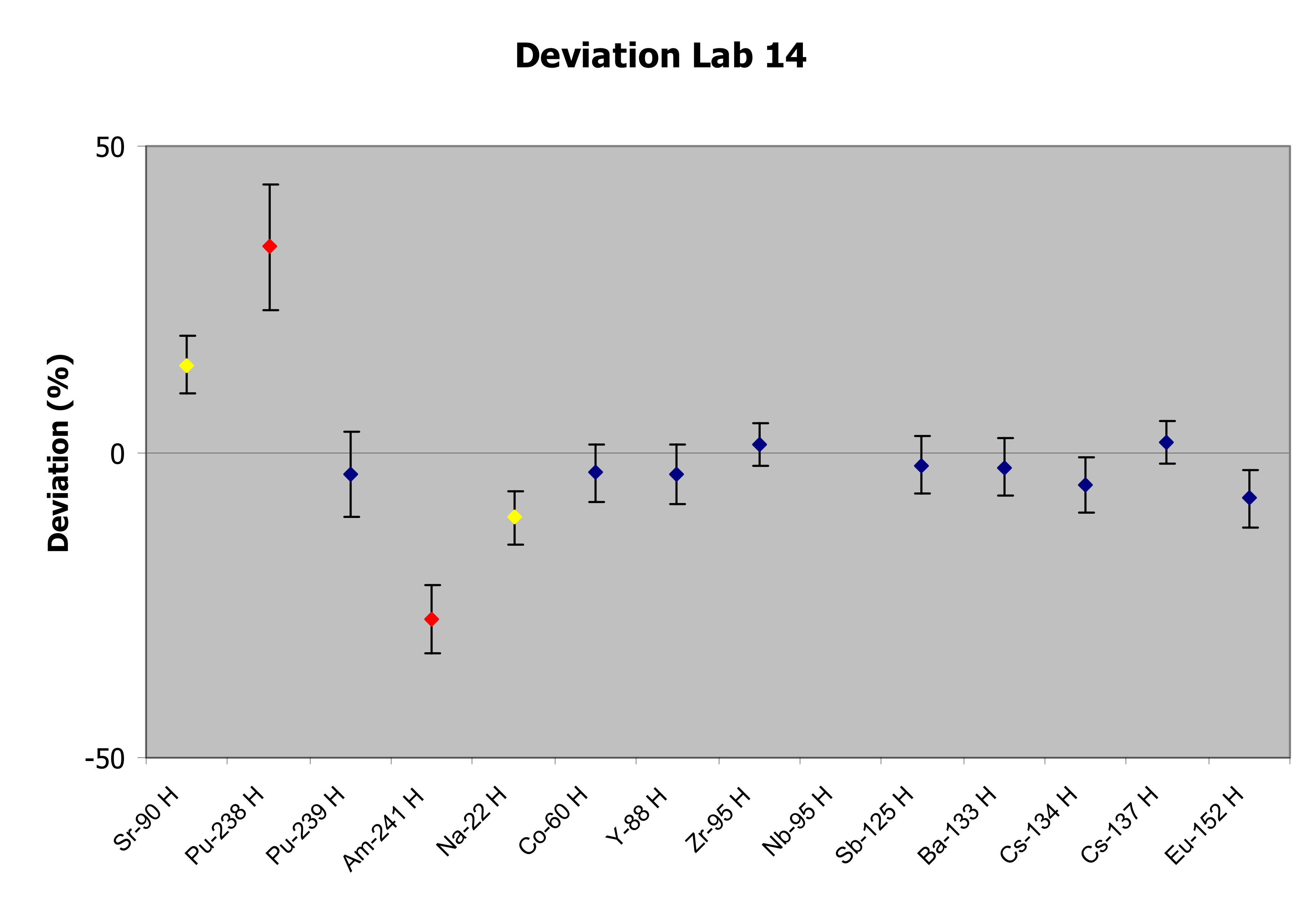


Figure 49 – Laboratory 15

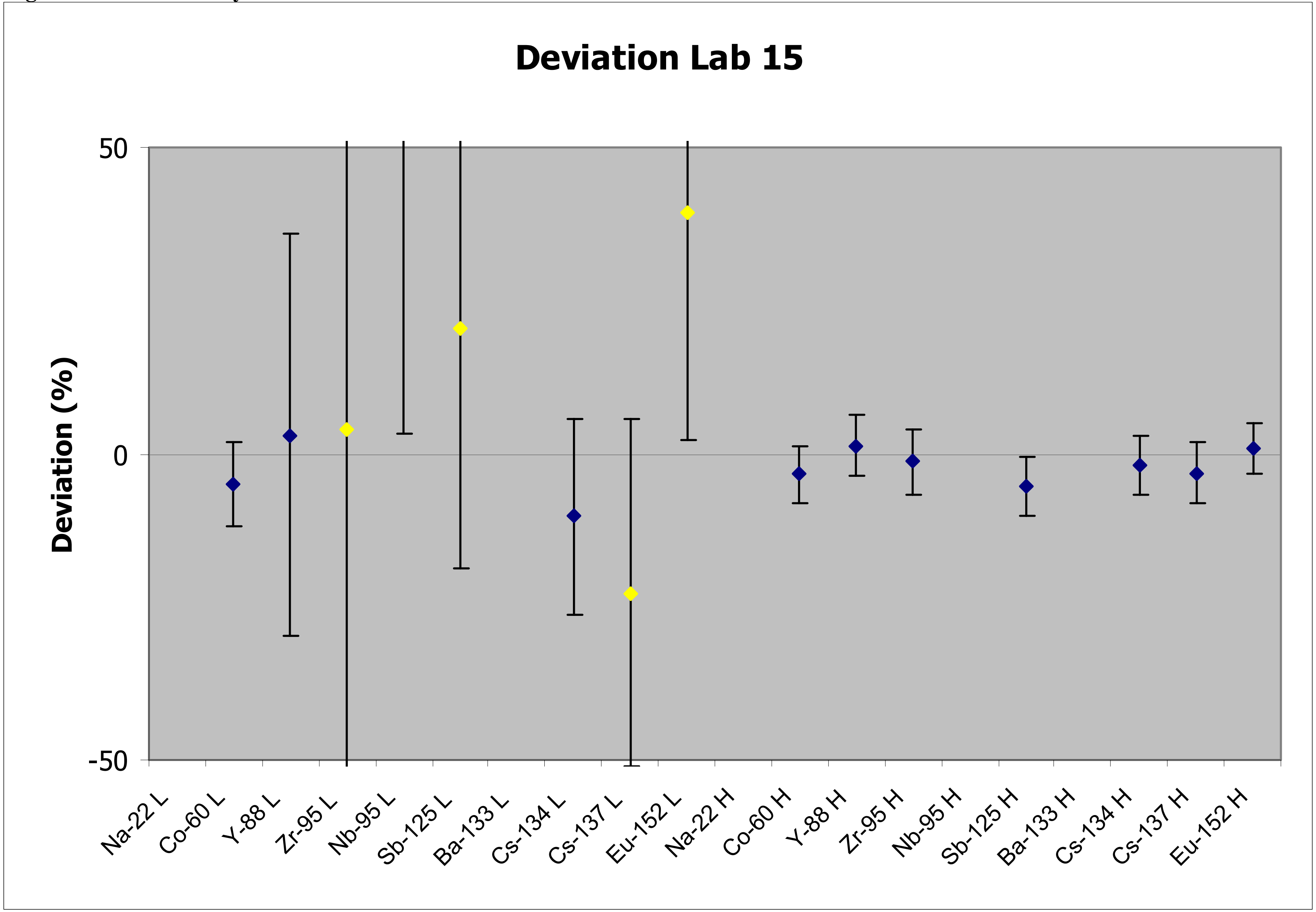


Figure 50 – Laboratory 17

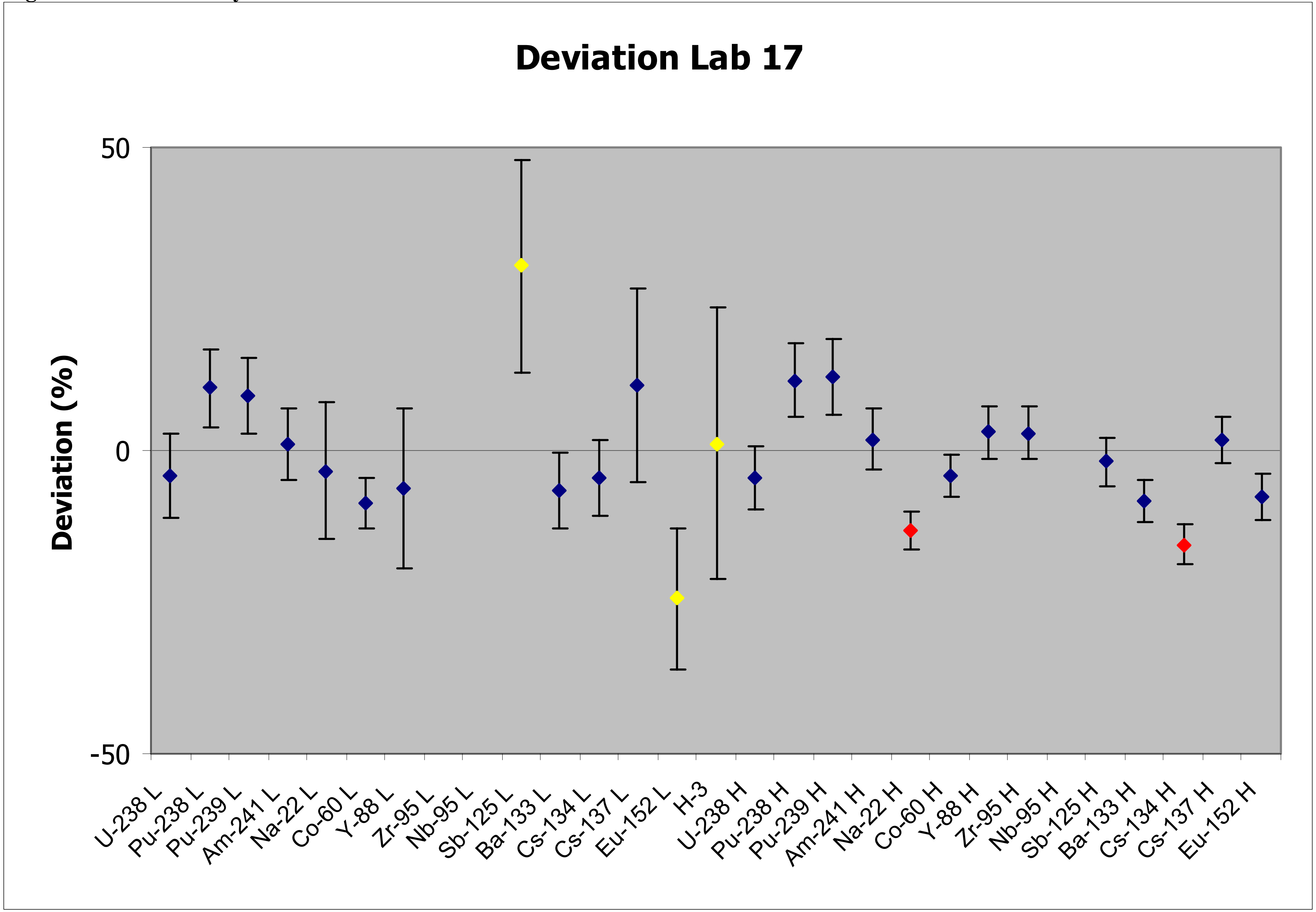


Figure 51 – Laboratory 18

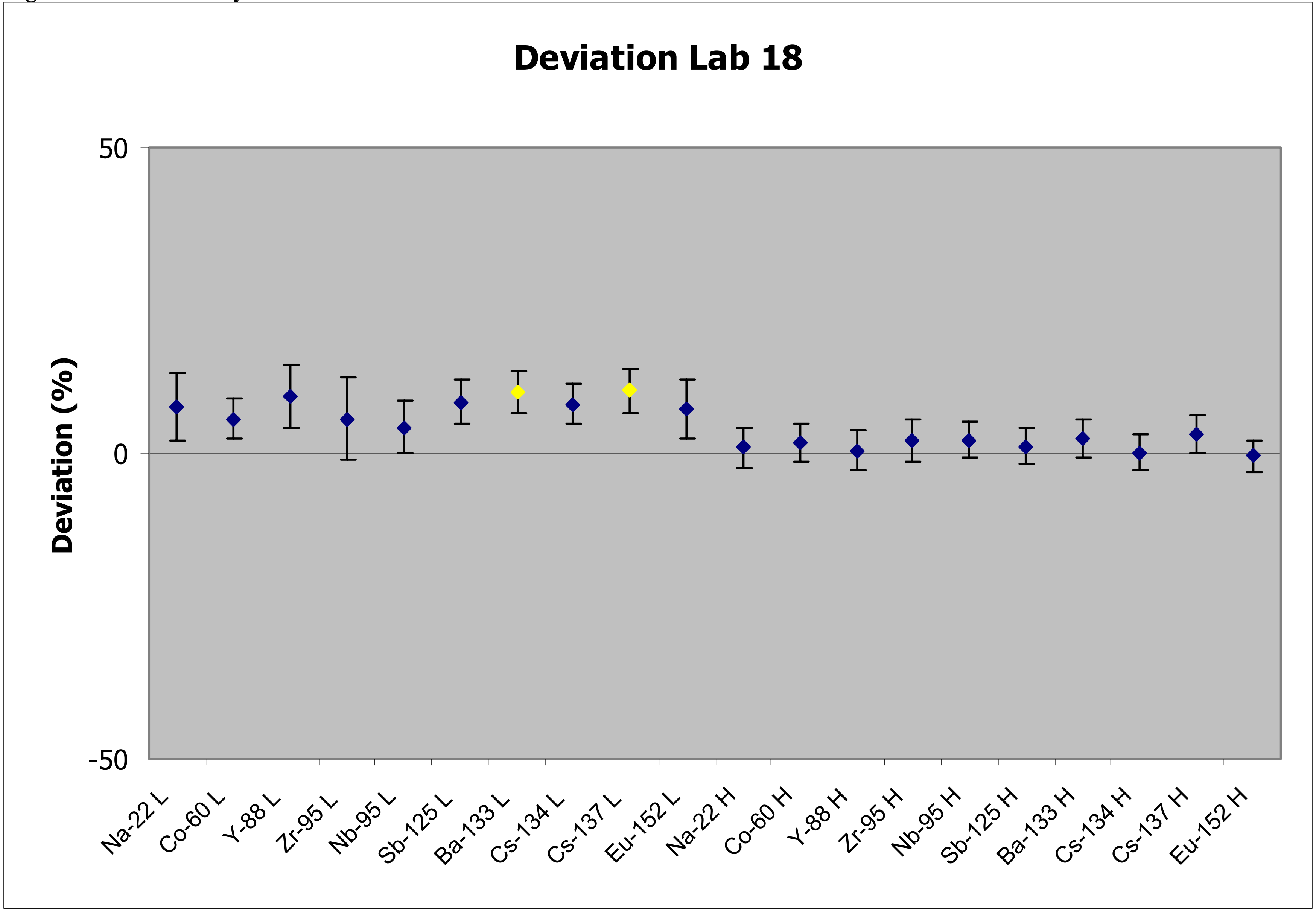


Figure 52 – Laboratory 19

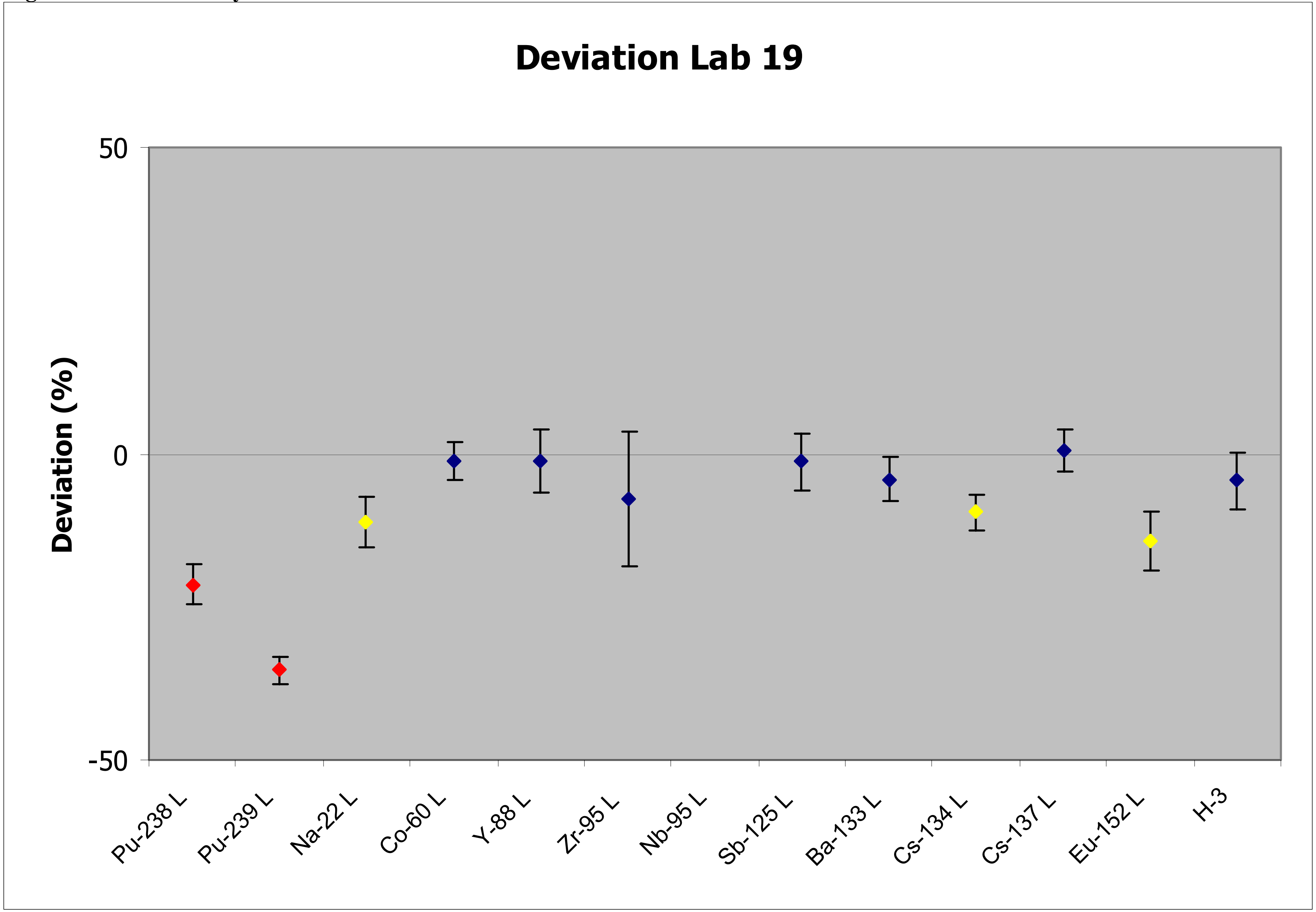


Figure 53 – Laboratory 21

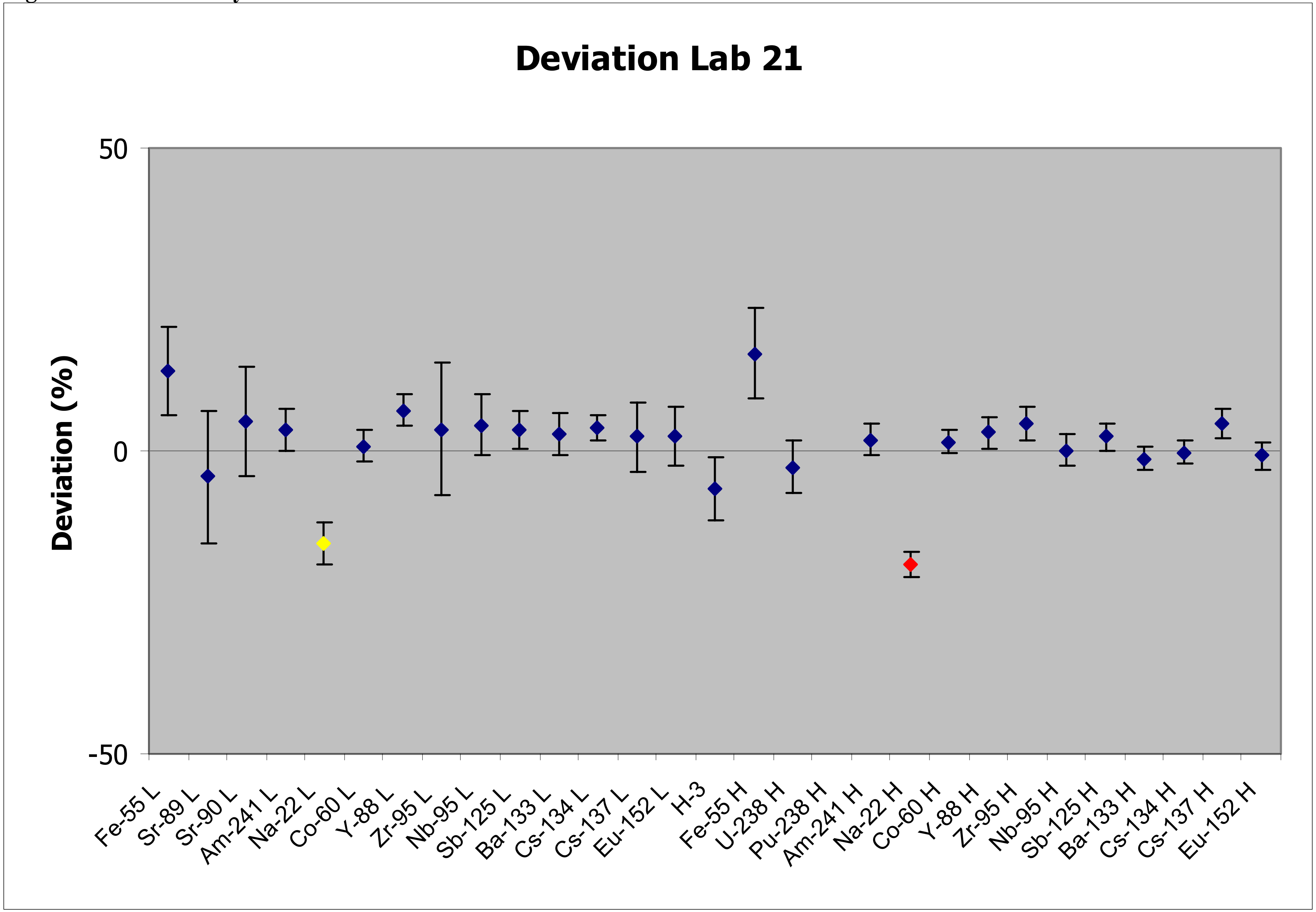


Figure 54 – Laboratory 22

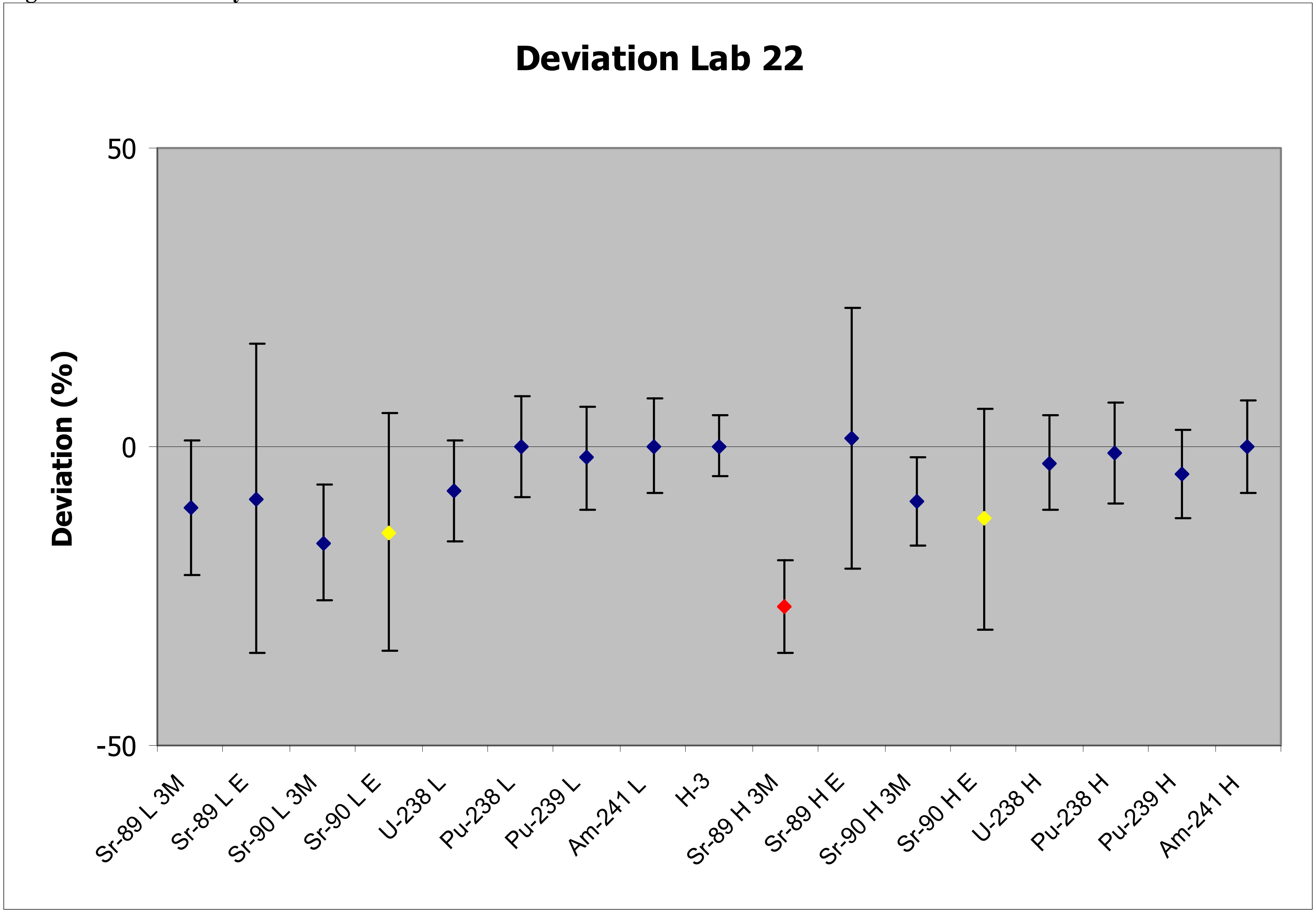


Figure 55 – Laboratory 23

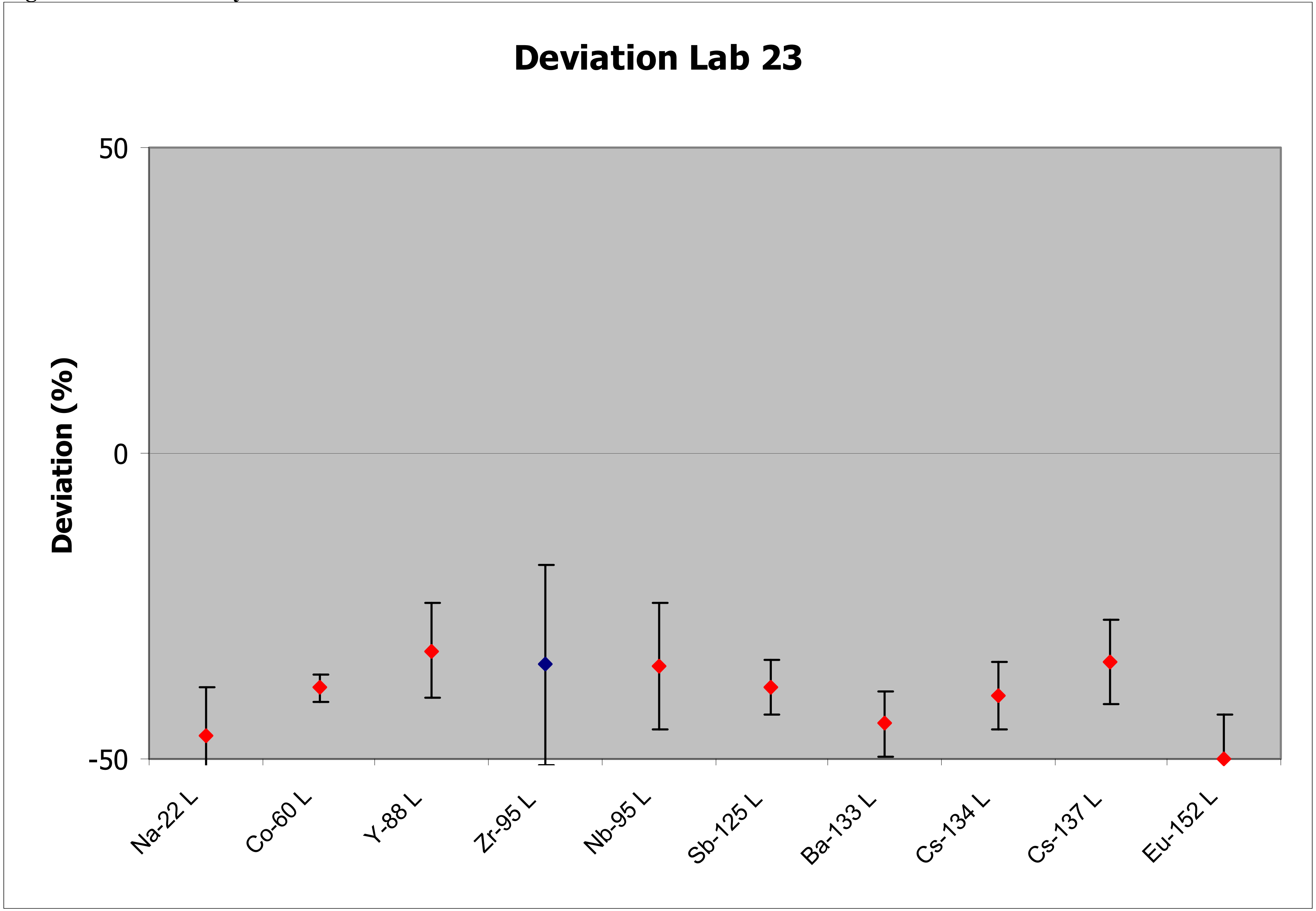


Figure 56 – Laboratory 24

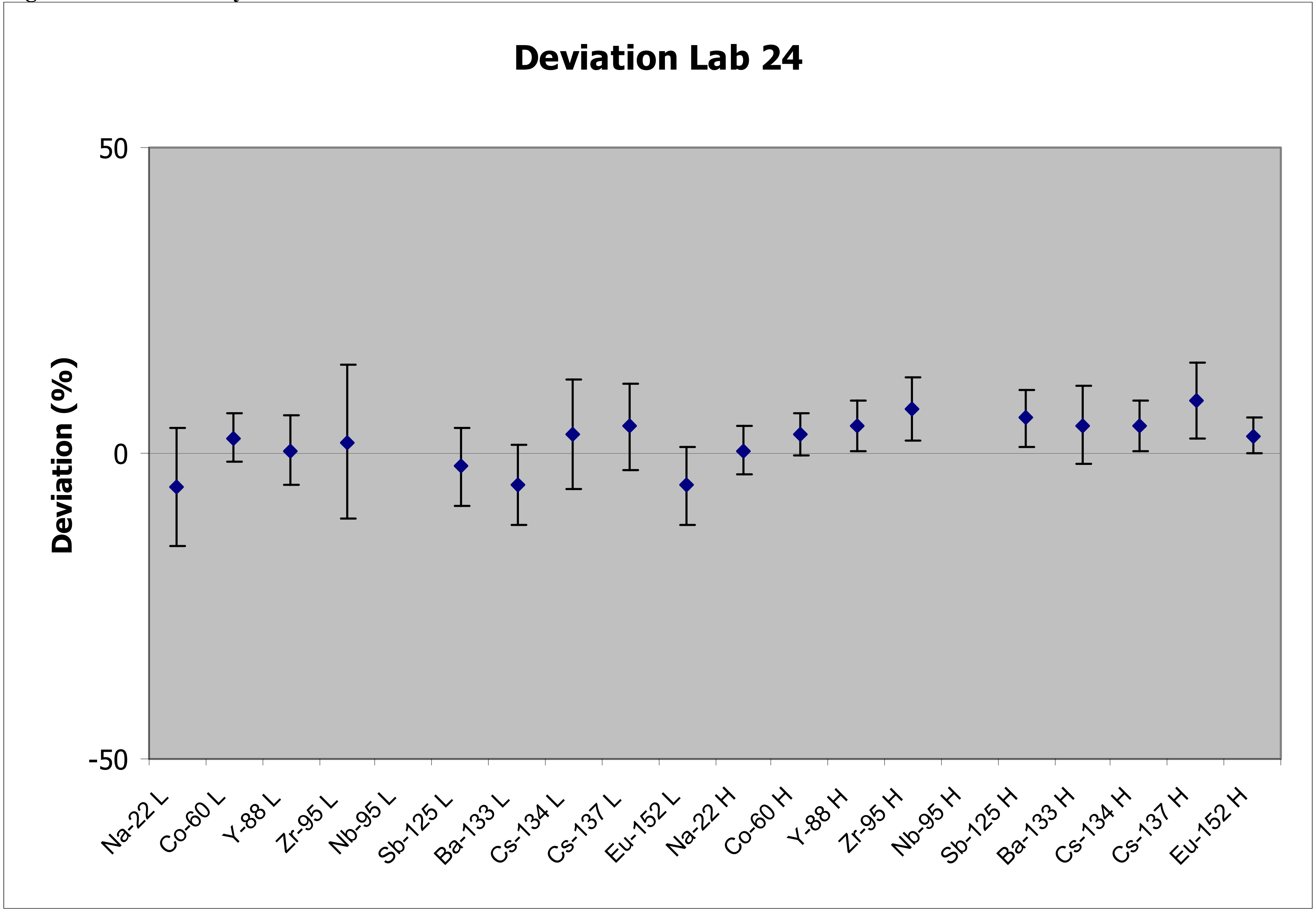


Figure 57 – Laboratory 25

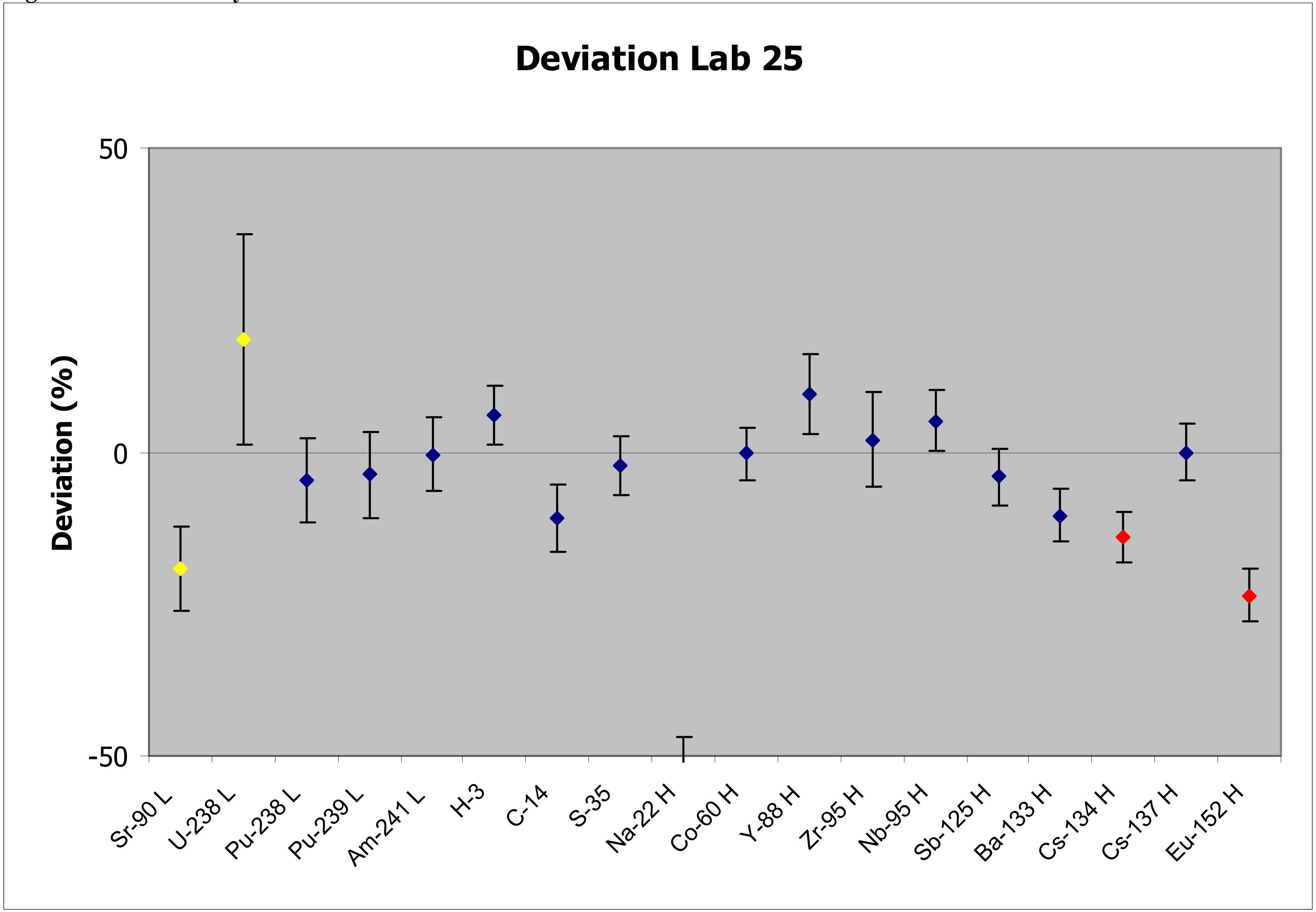


Figure 58 – Laboratory 26

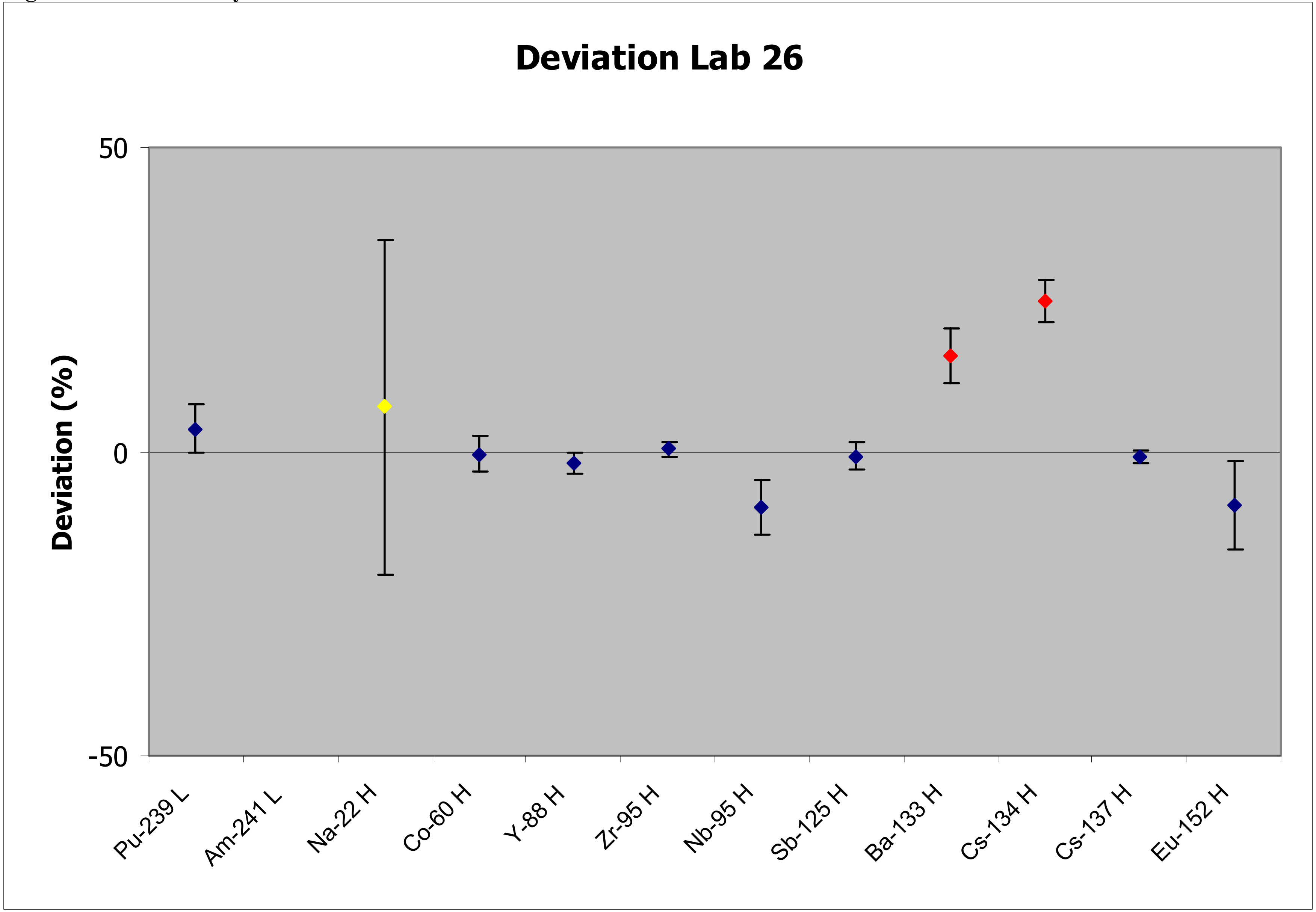


Figure 59 – Laboratory 27

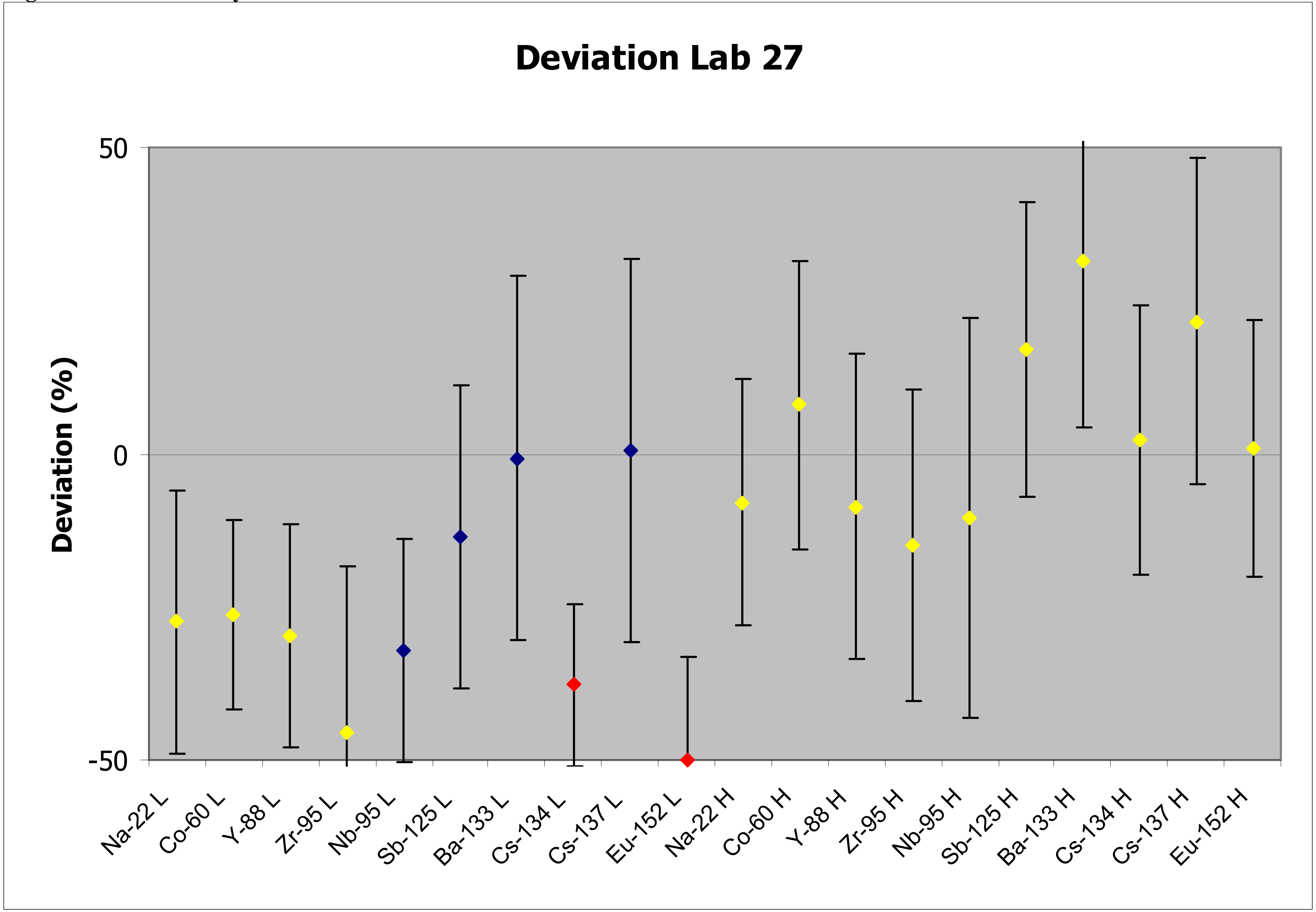


Figure 60 – Laboratory 28

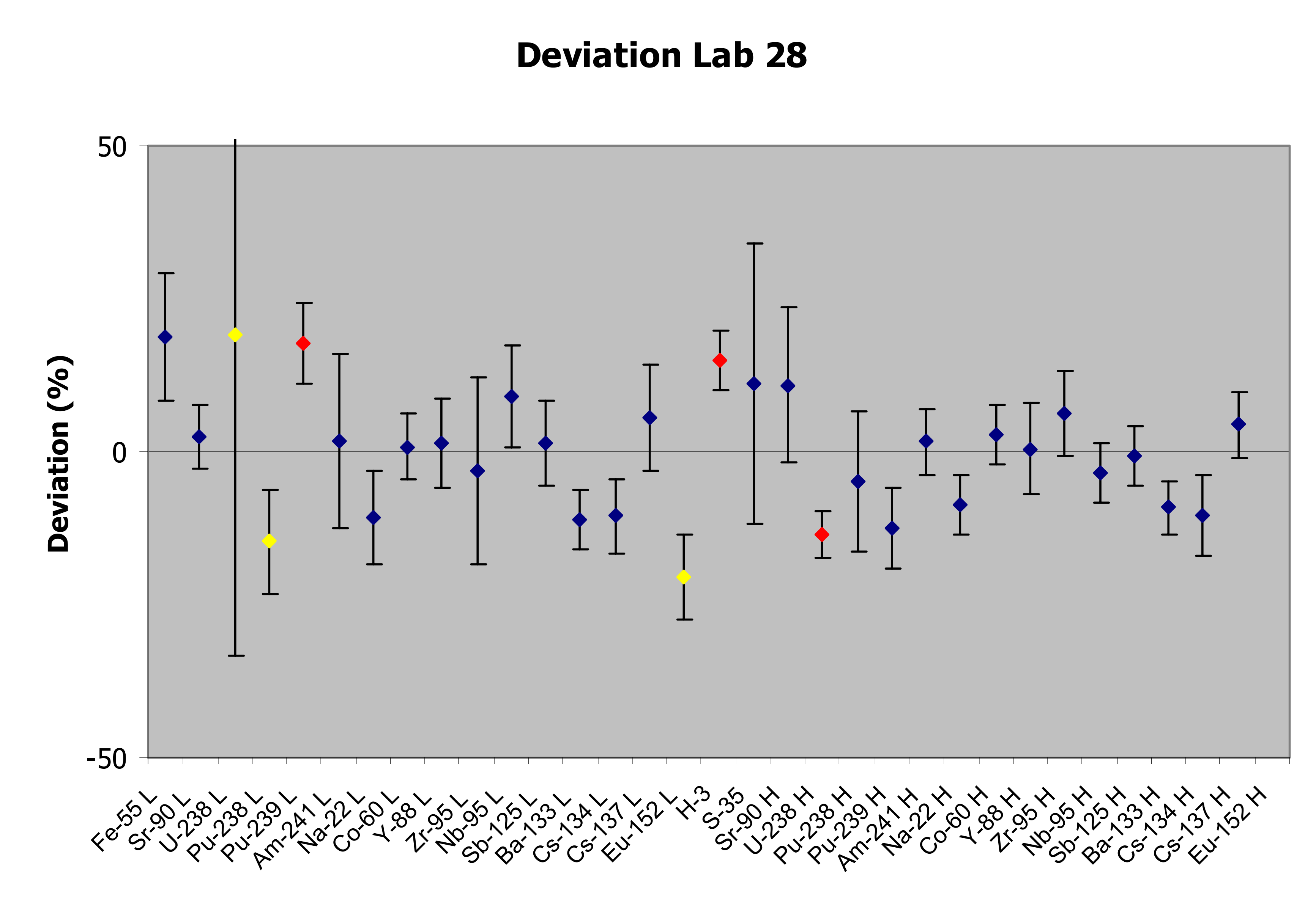


Figure 61 – Laboratory 29

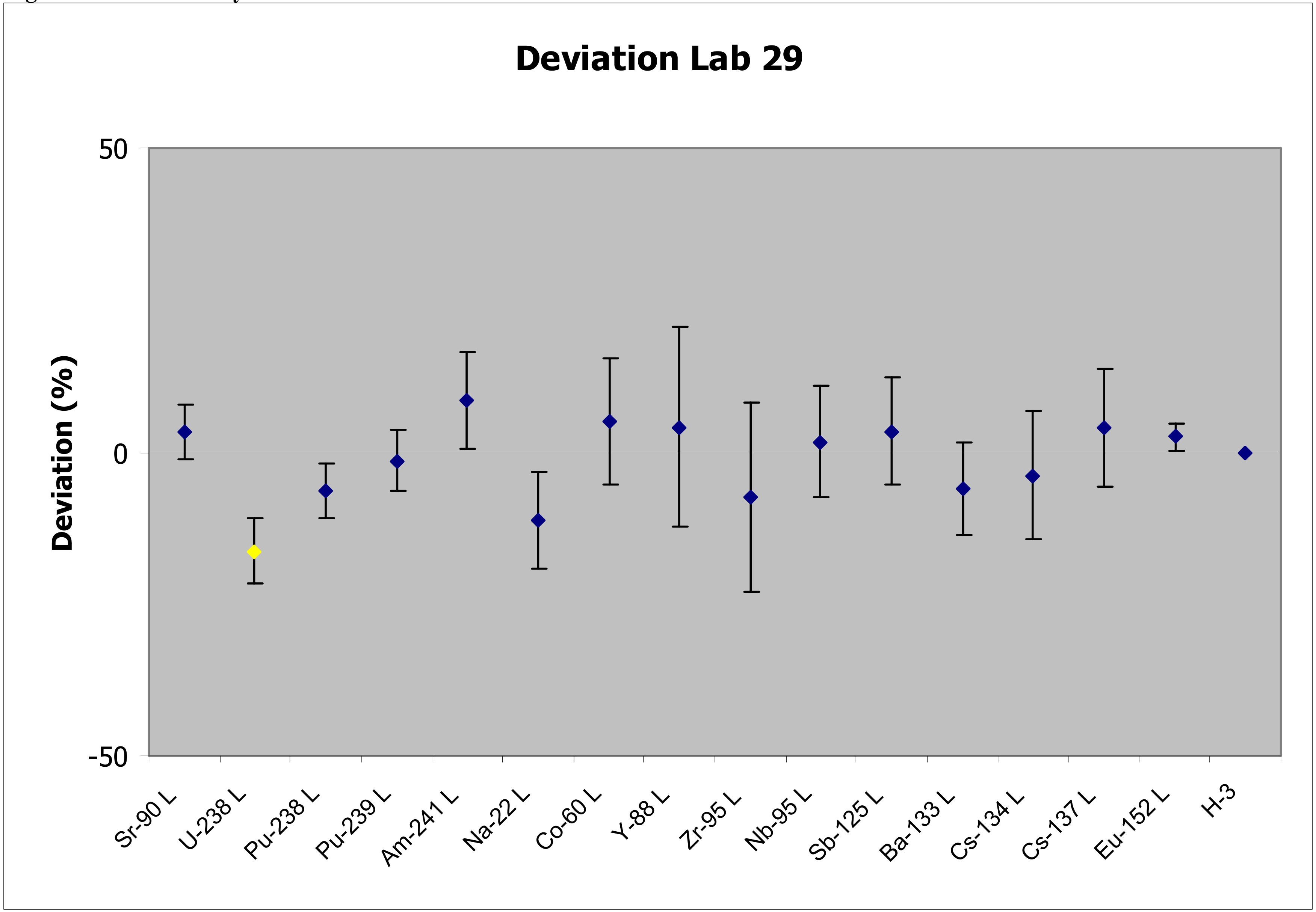


Figure 62 – Laboratory 32

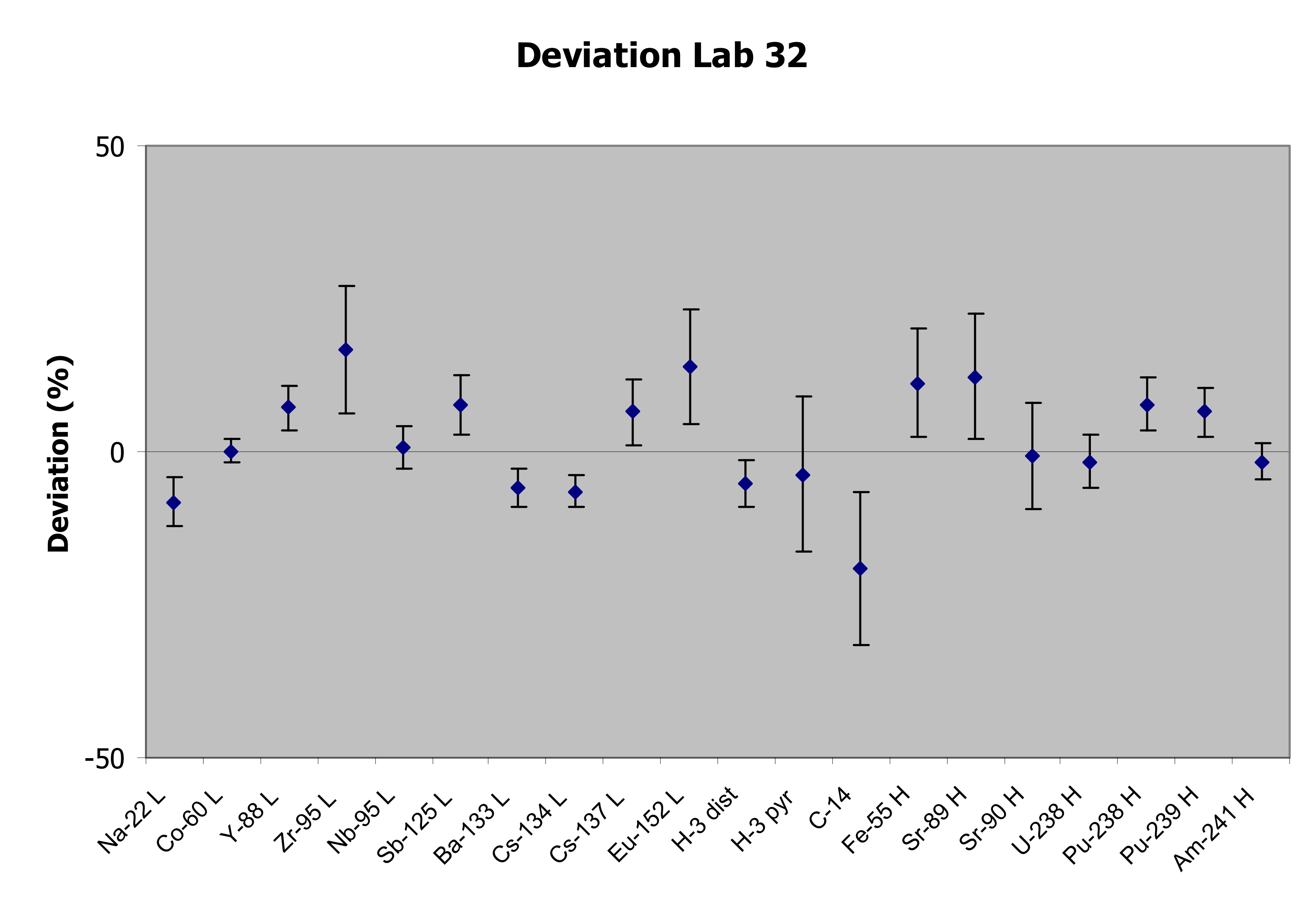


Figure 63 – Laboratory 34

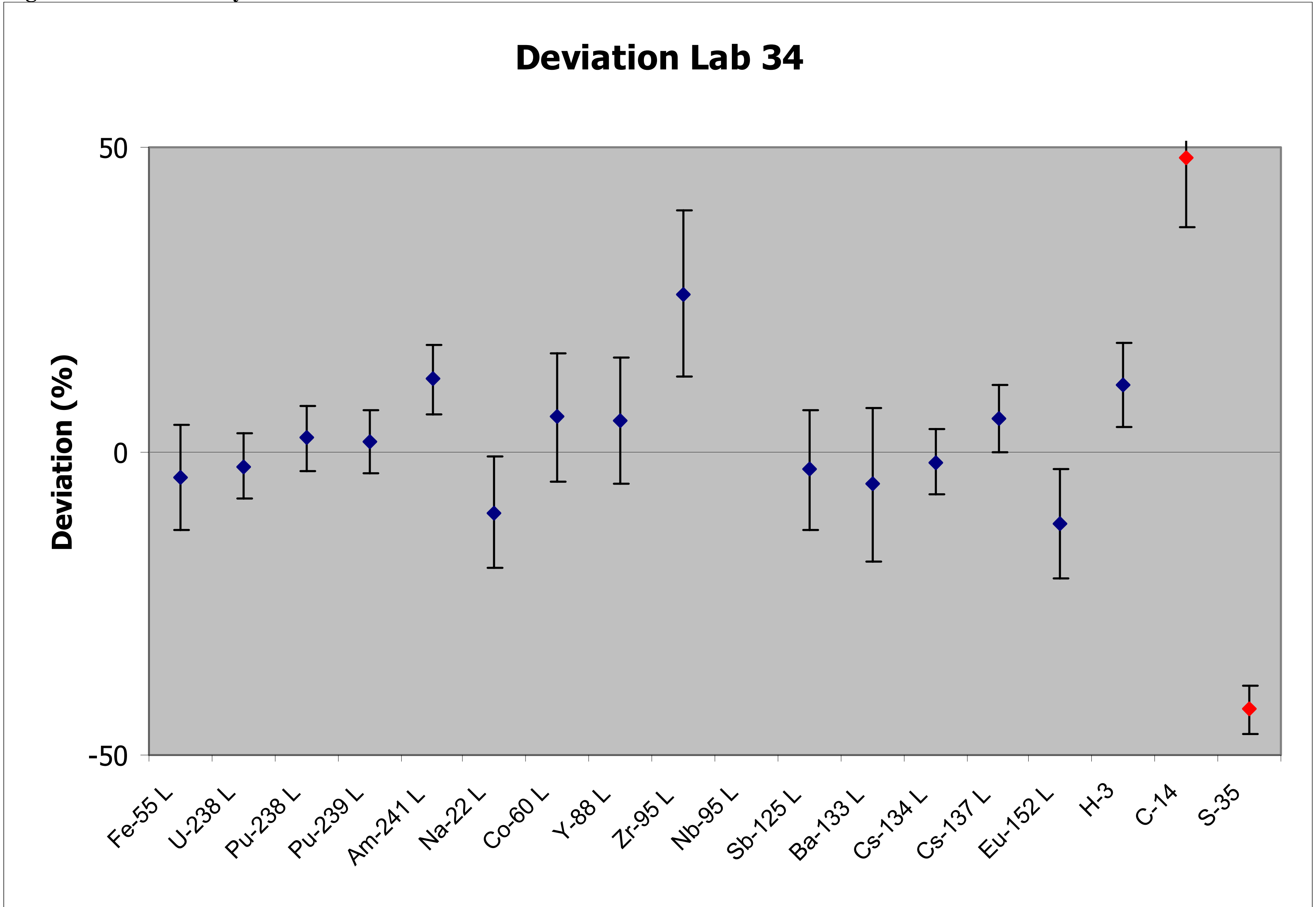


Figure 64 – Laboratory 35

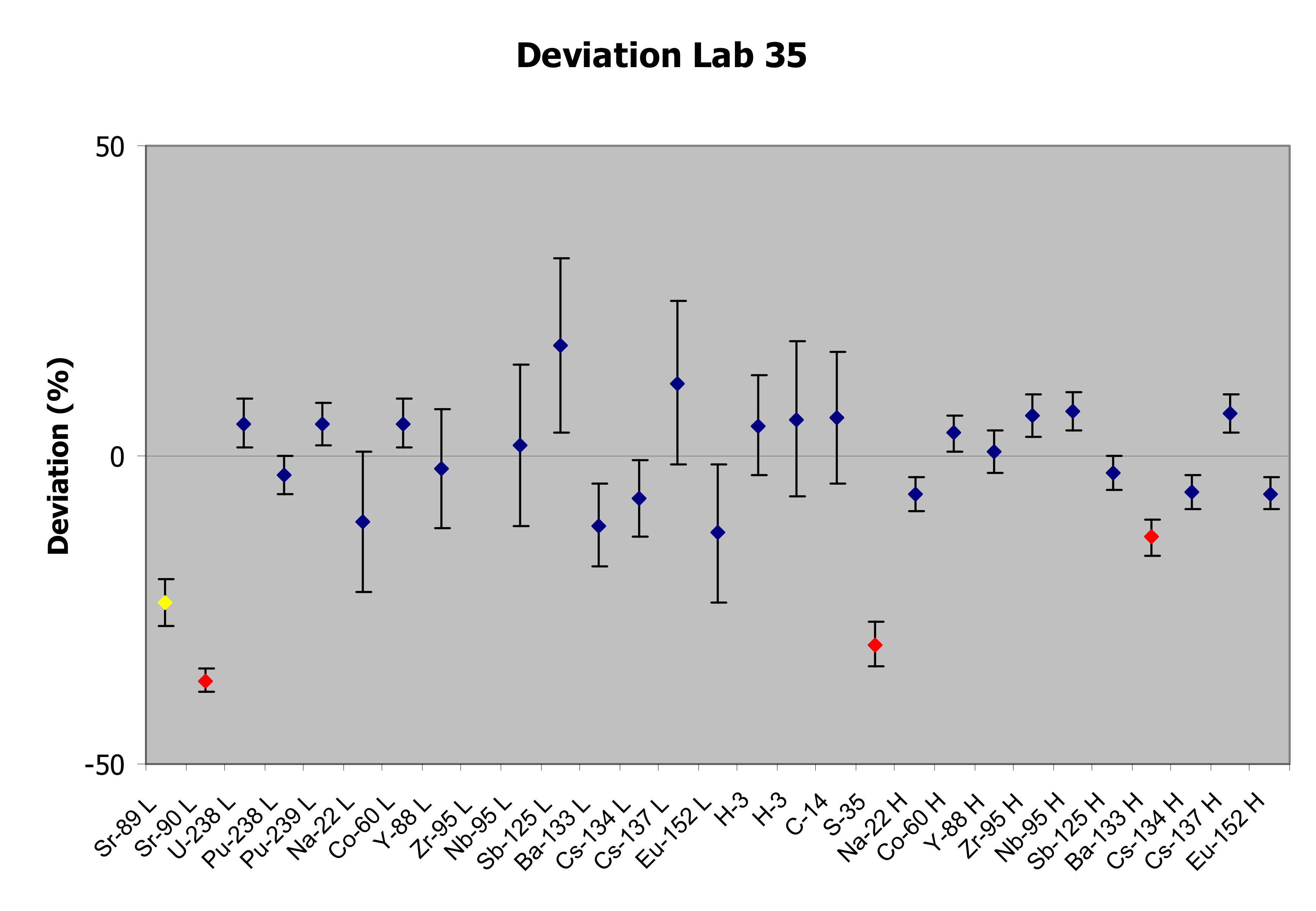


Figure 65 – Laboratory 36

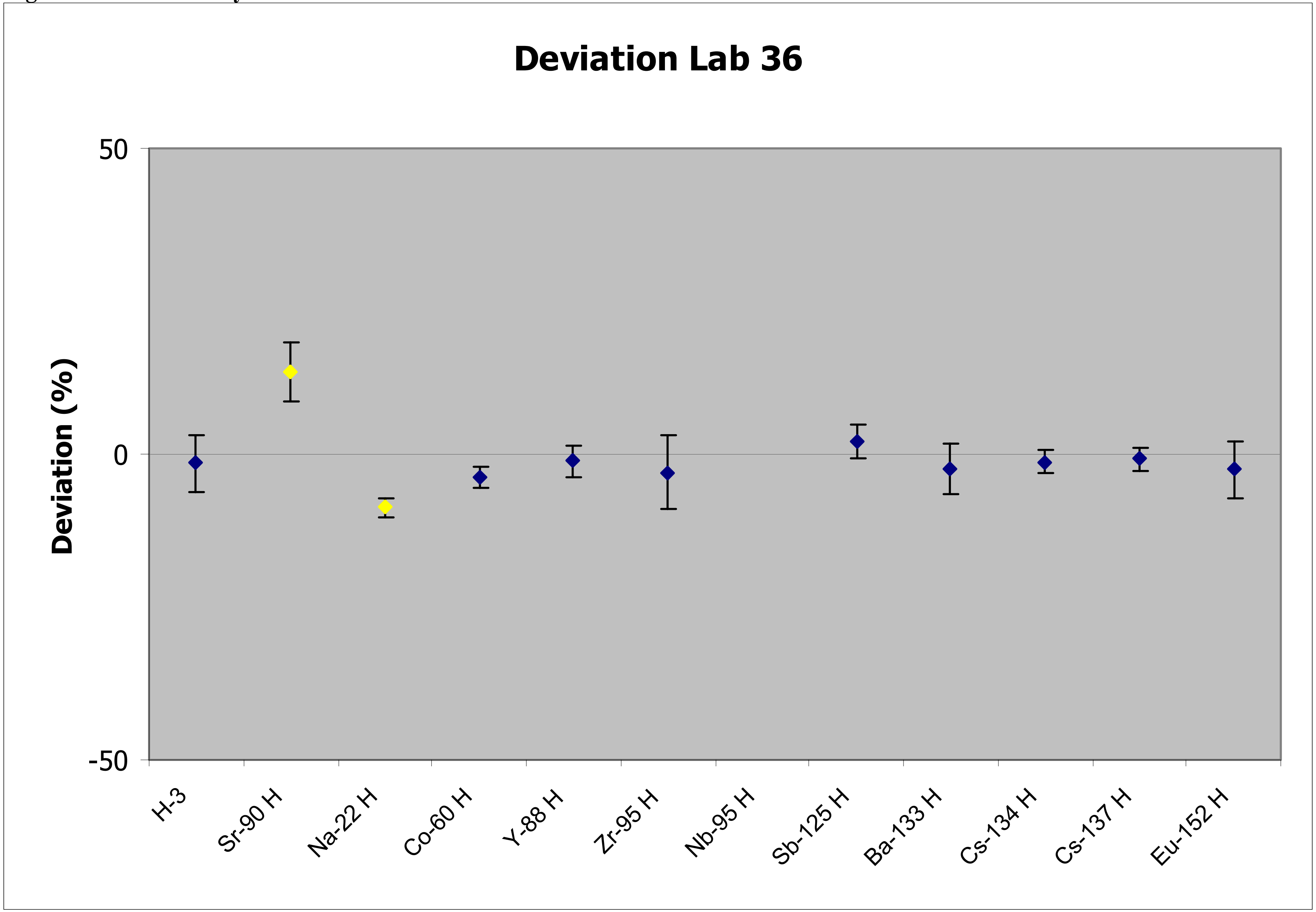


Figure 66 – Laboratory 38

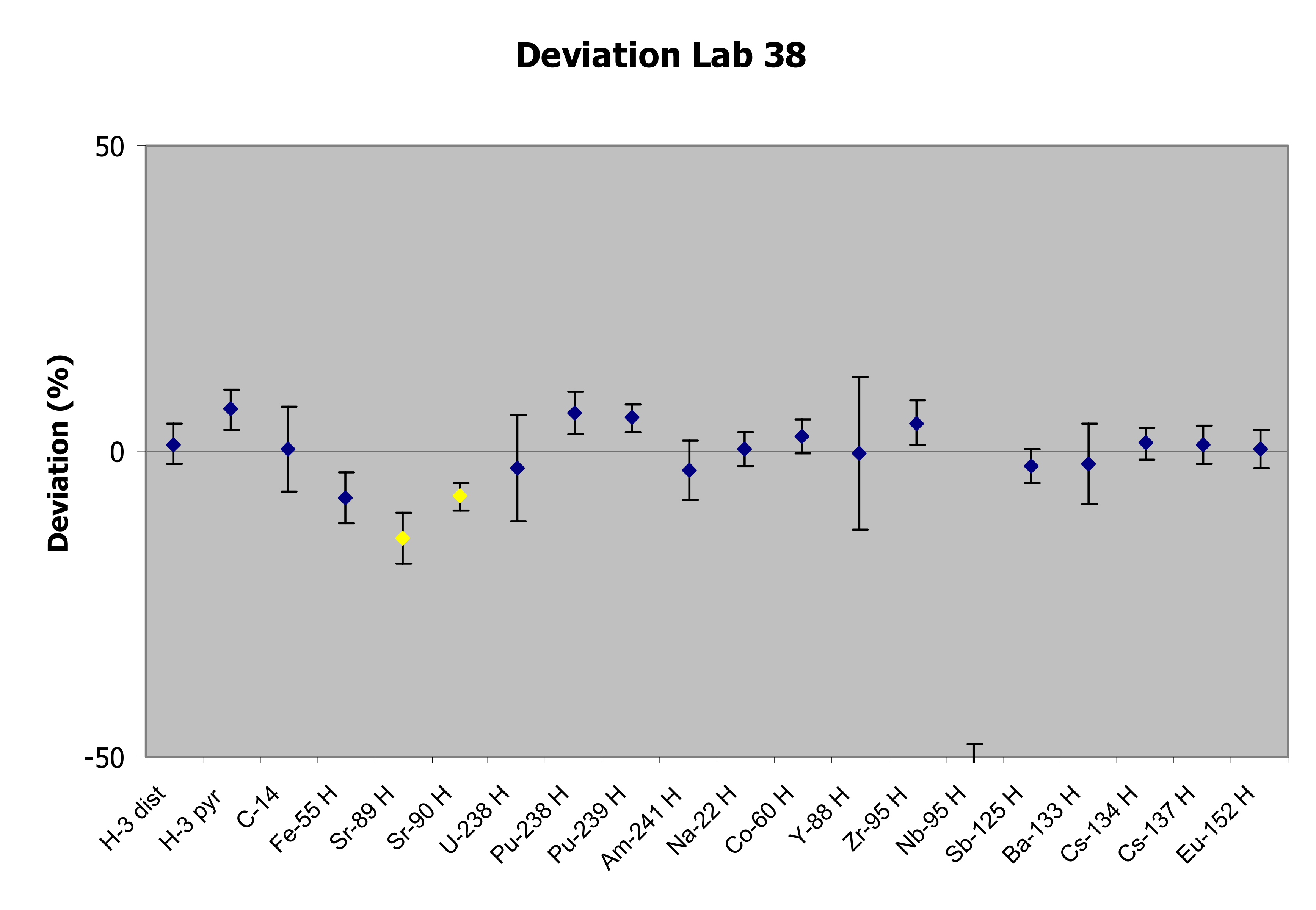


Figure 67 – Laboratory 40

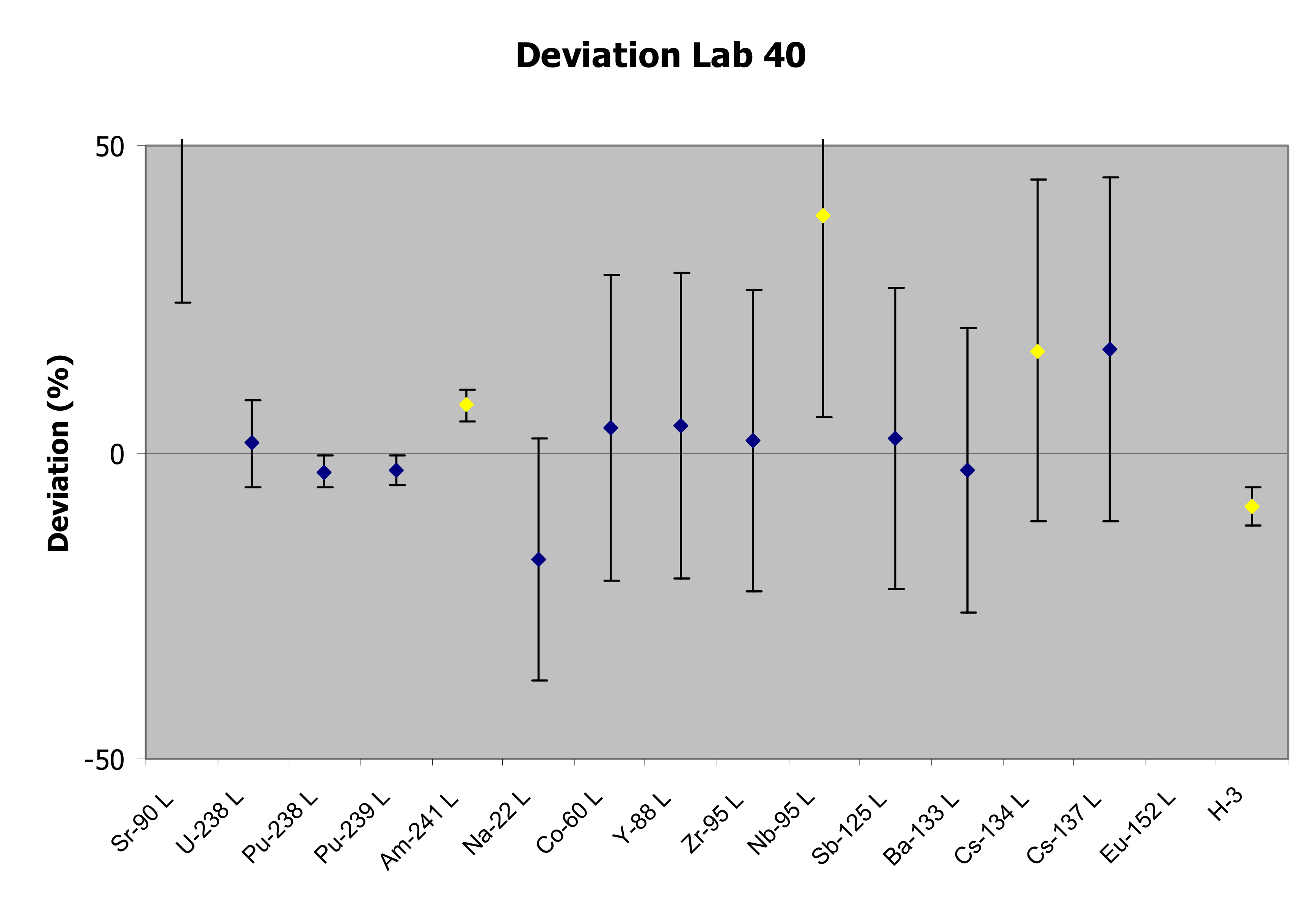


Figure 68 – Laboratory 41

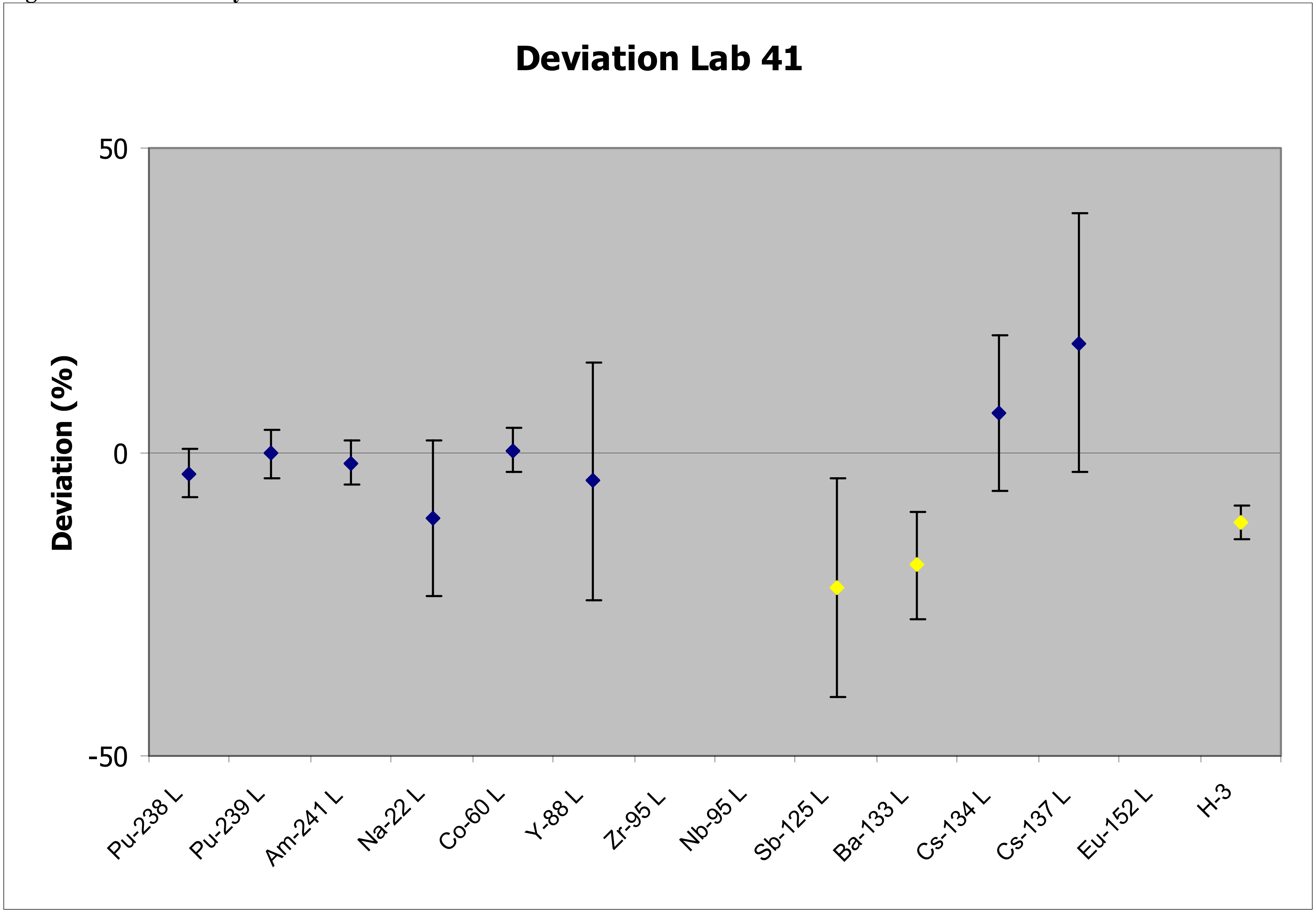


Figure 69 – Laboratory 42

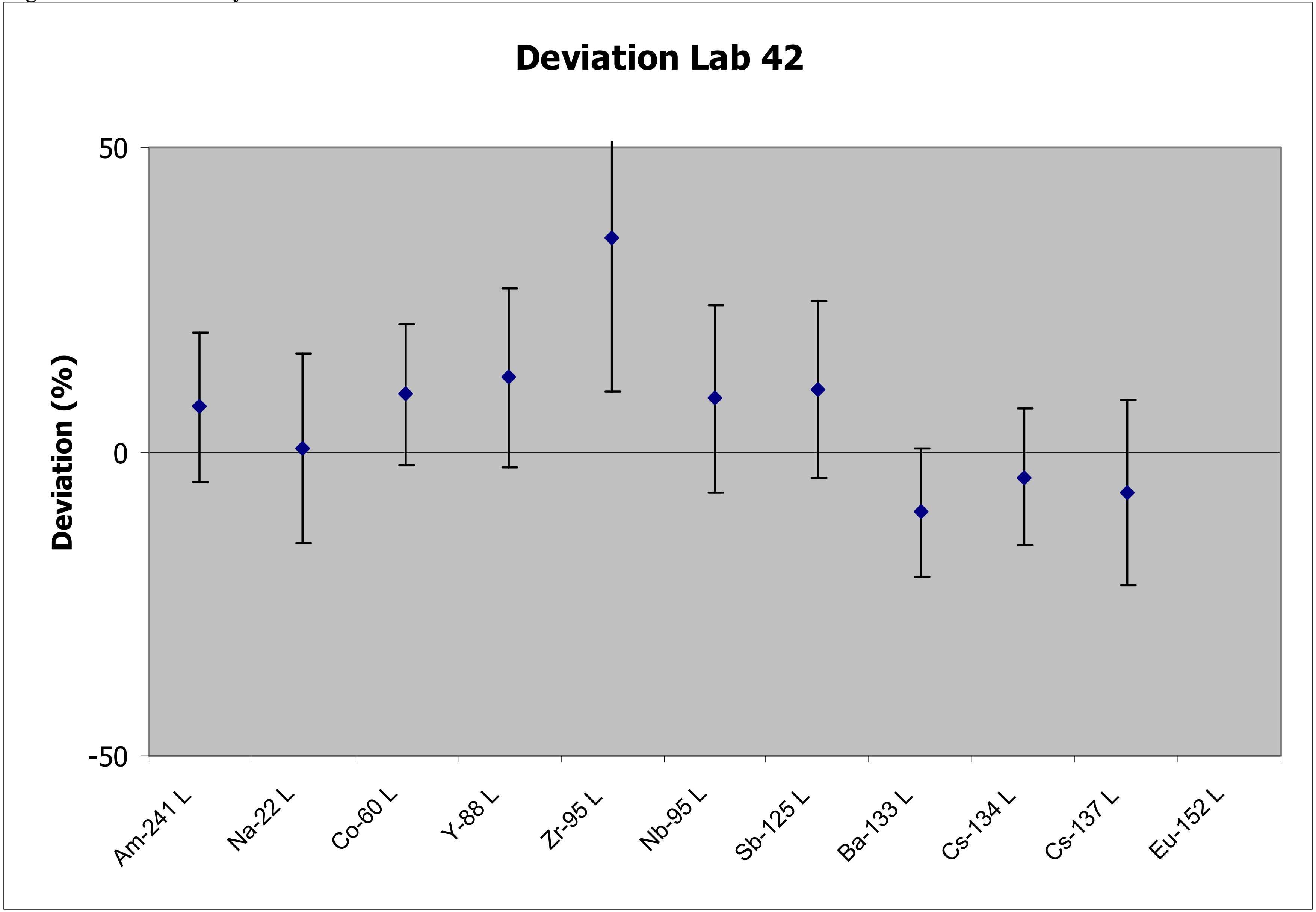


Figure 70 – Laboratory 45

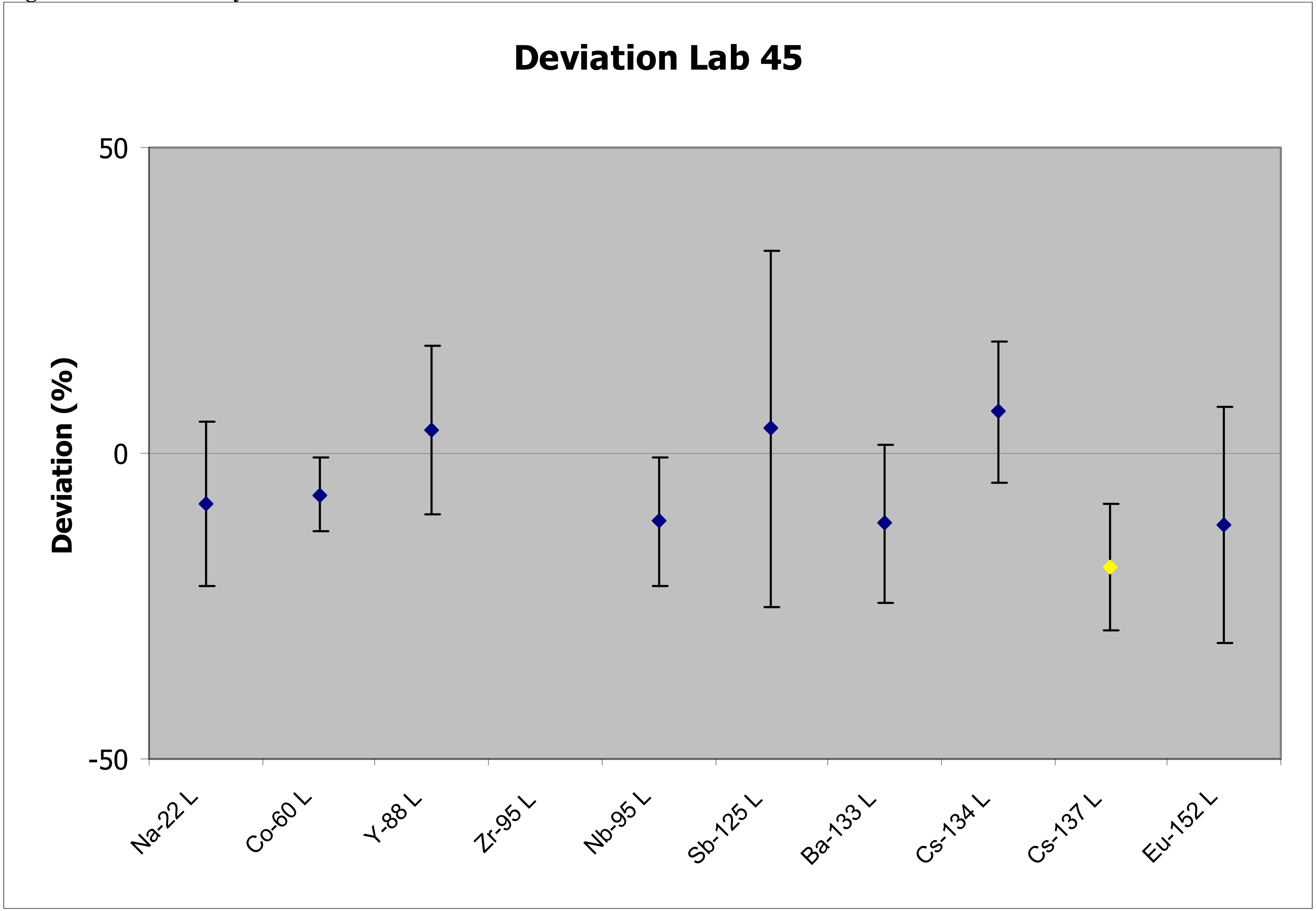


Figure 71 – Laboratory 46

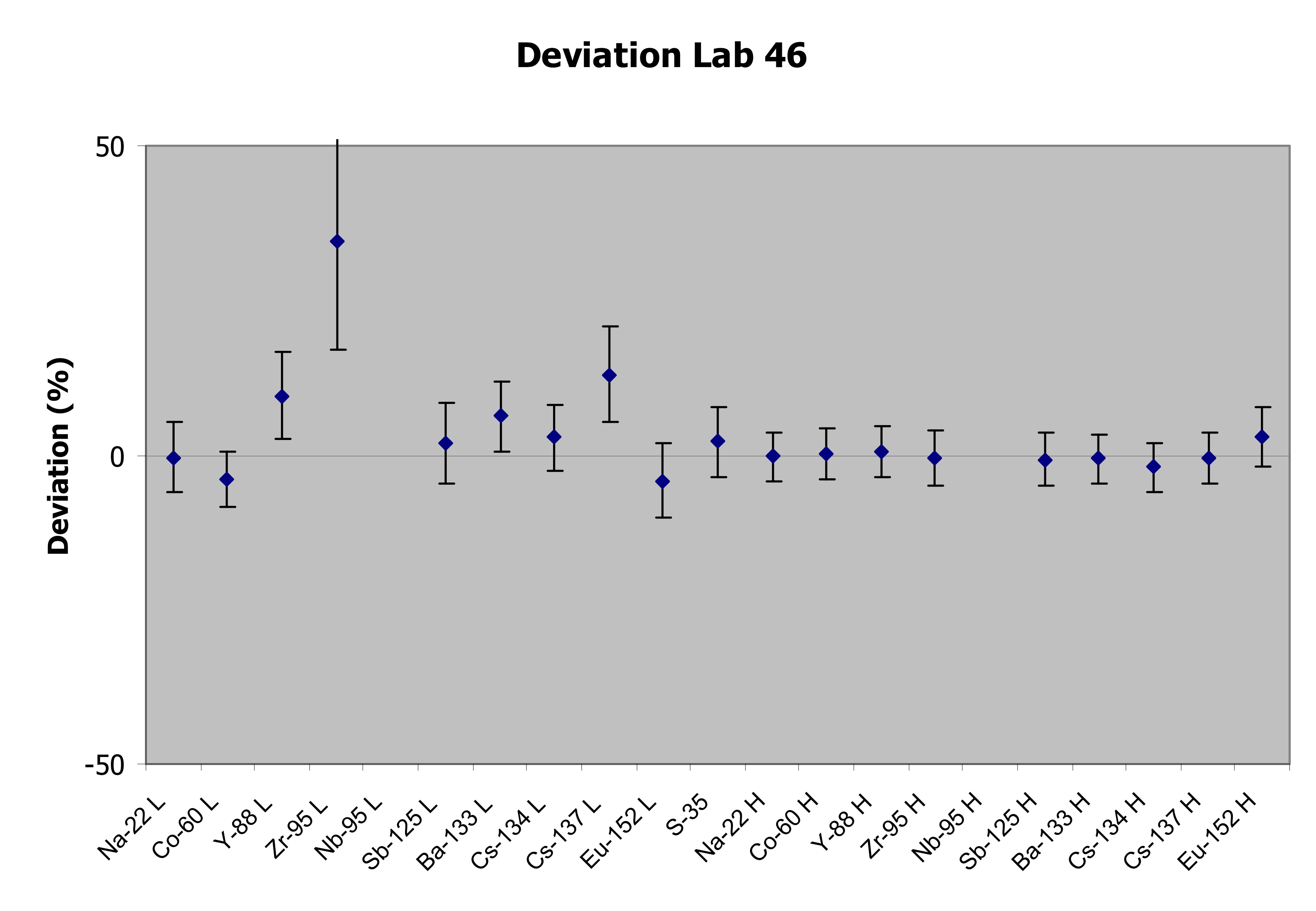


Figure 72 – Laboratory 47

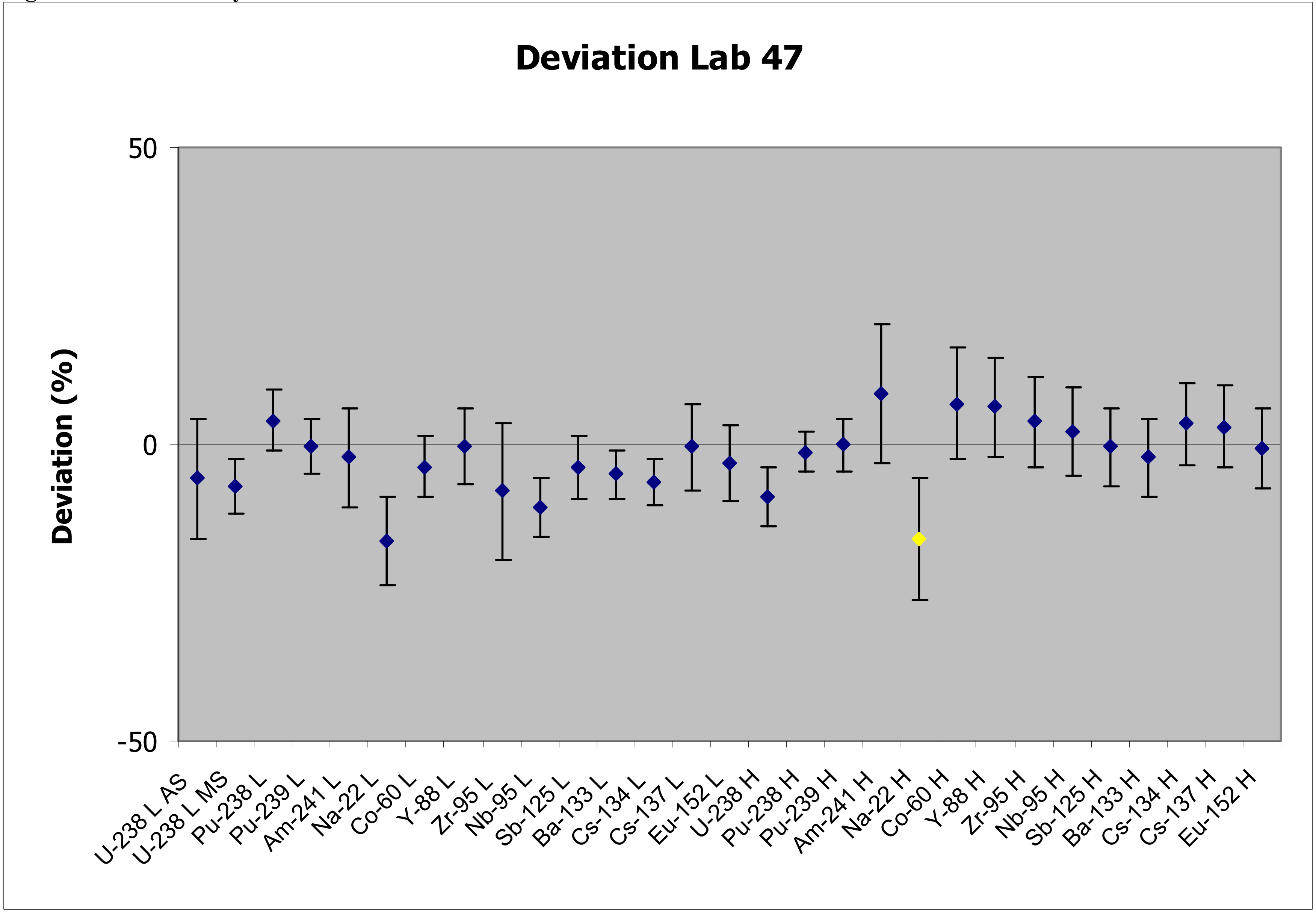


Figure 73 – Laboratory 48

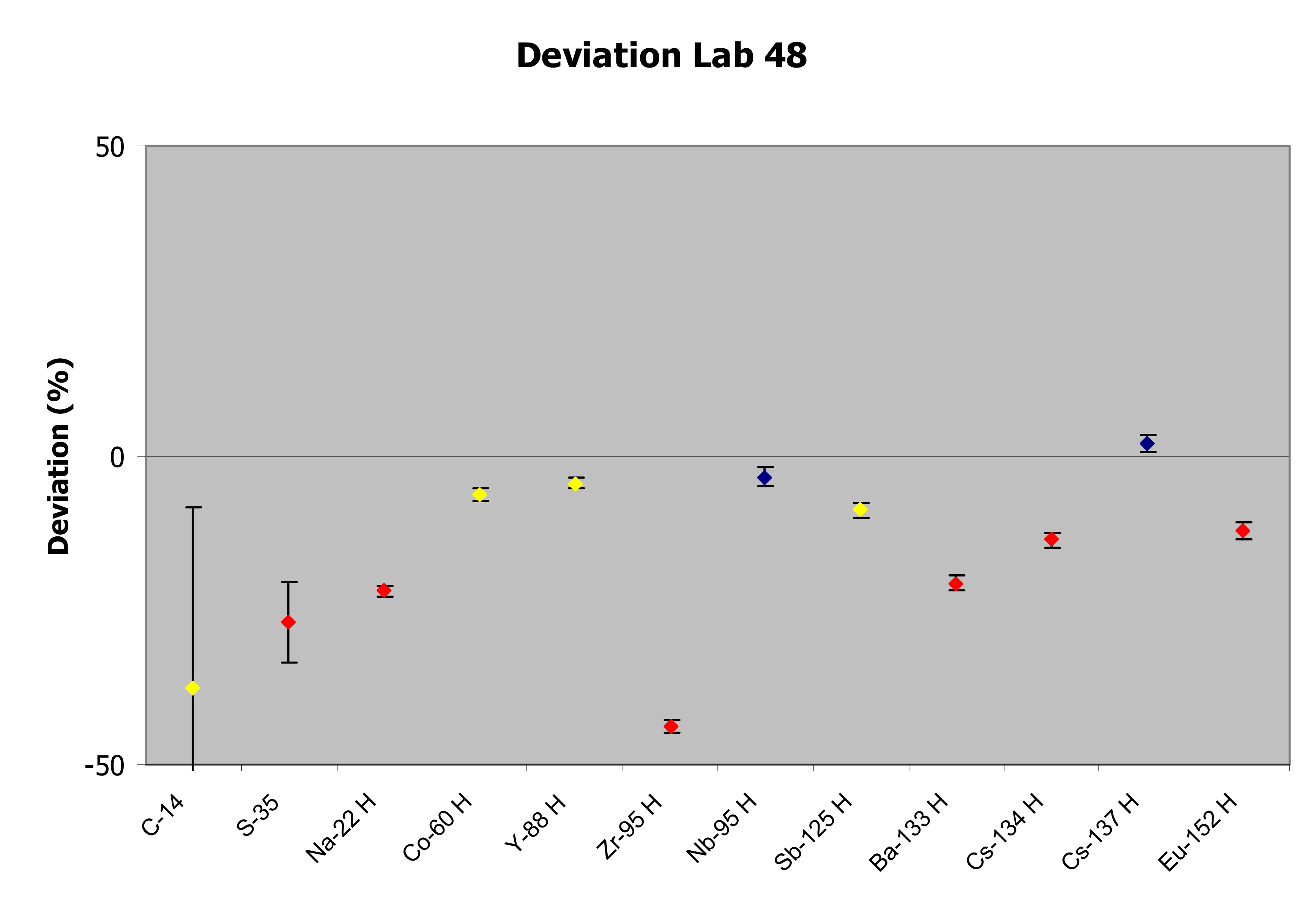


Figure 74 – Laboratory 49

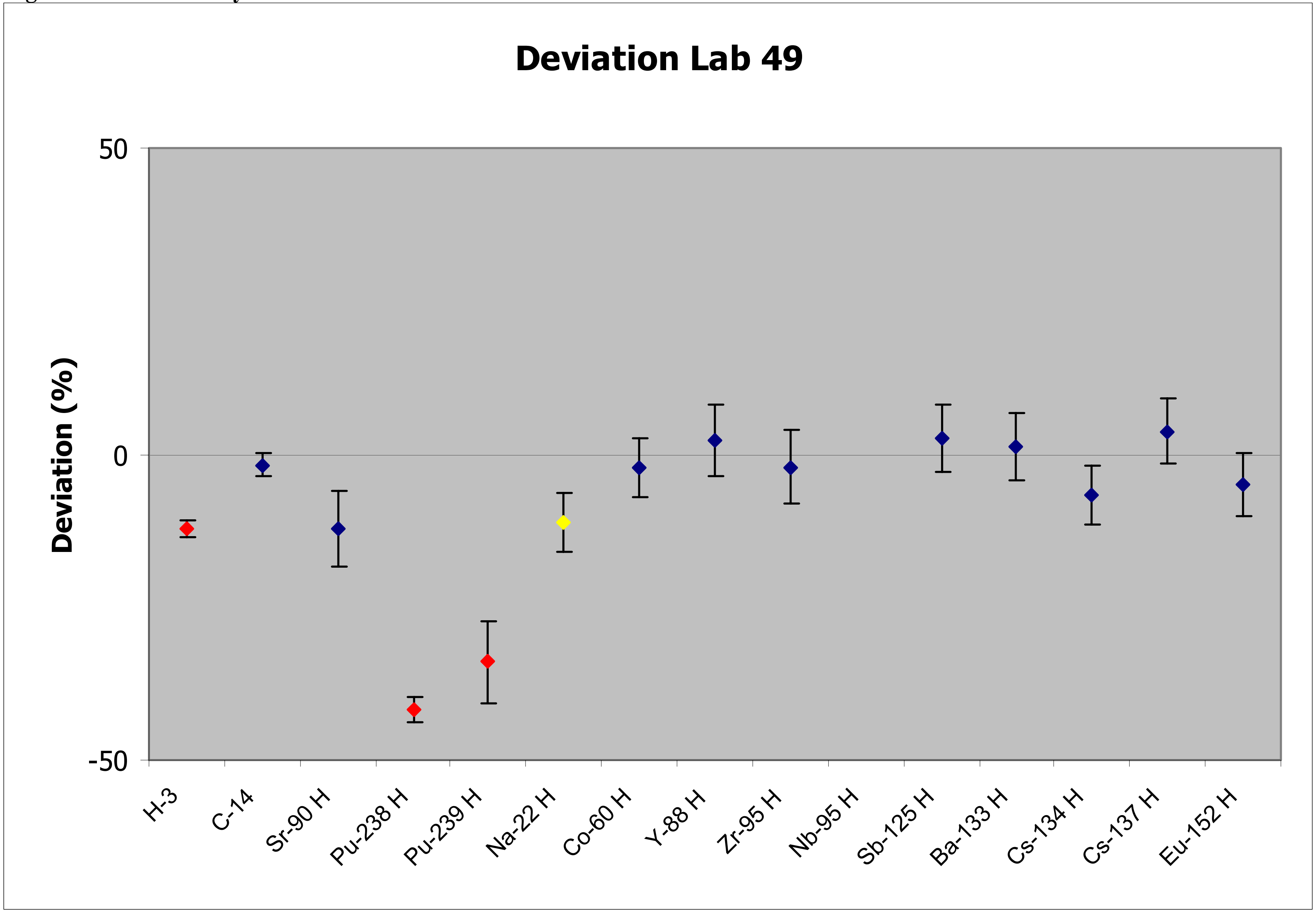


Figure 75 – Laboratory 50

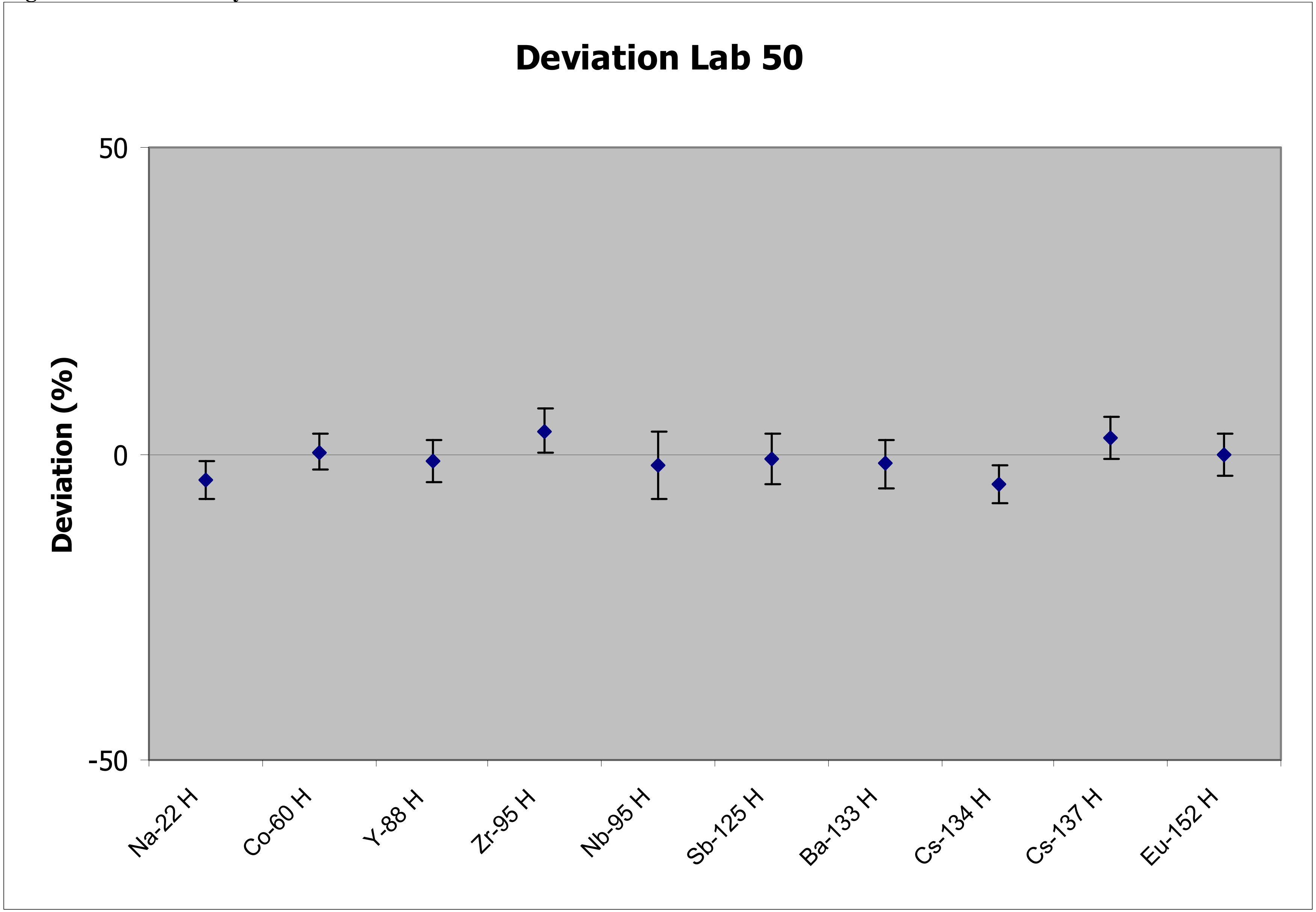


Figure 76 – Laboratory 51

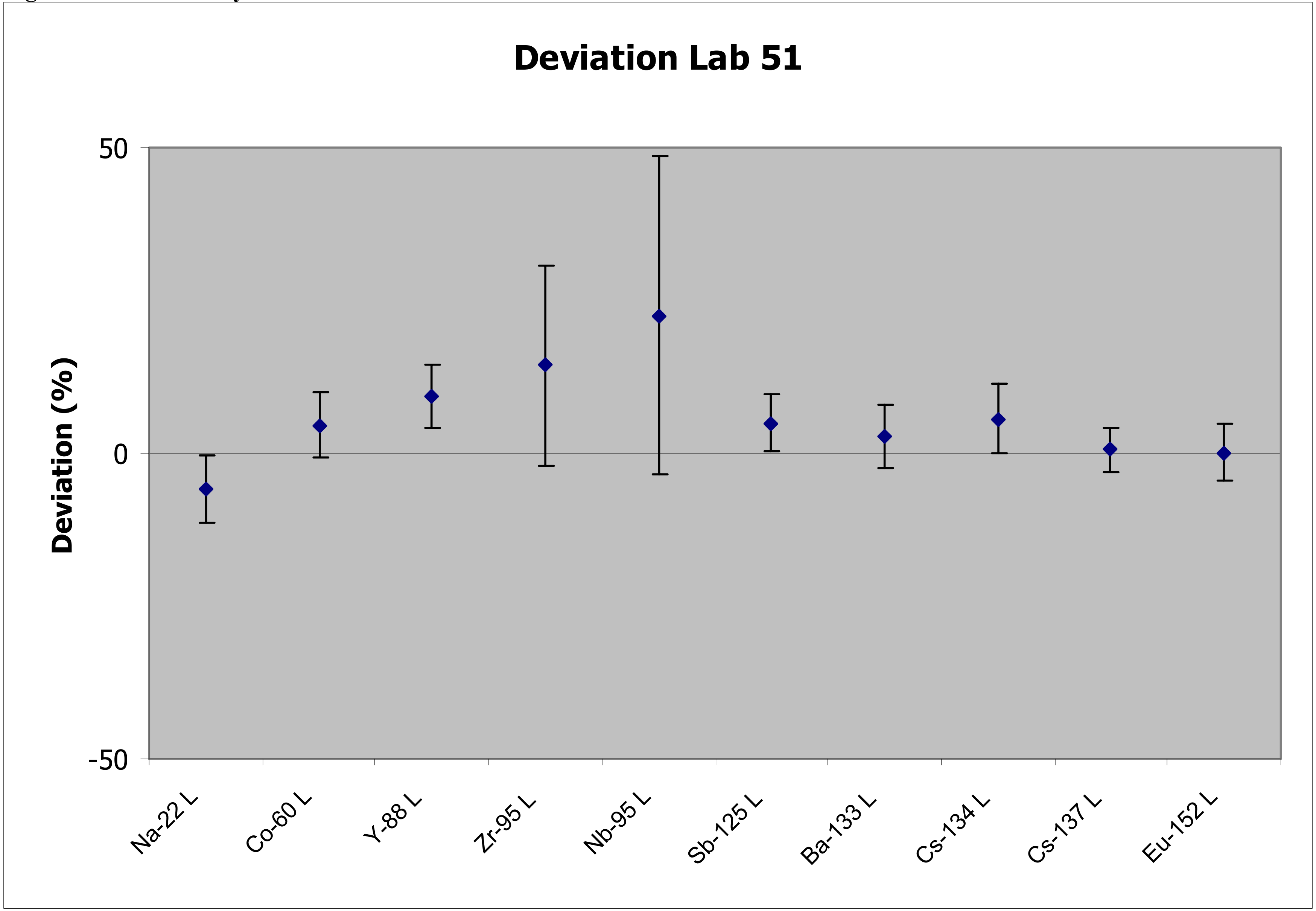


Figure 77 – Laboratory 52

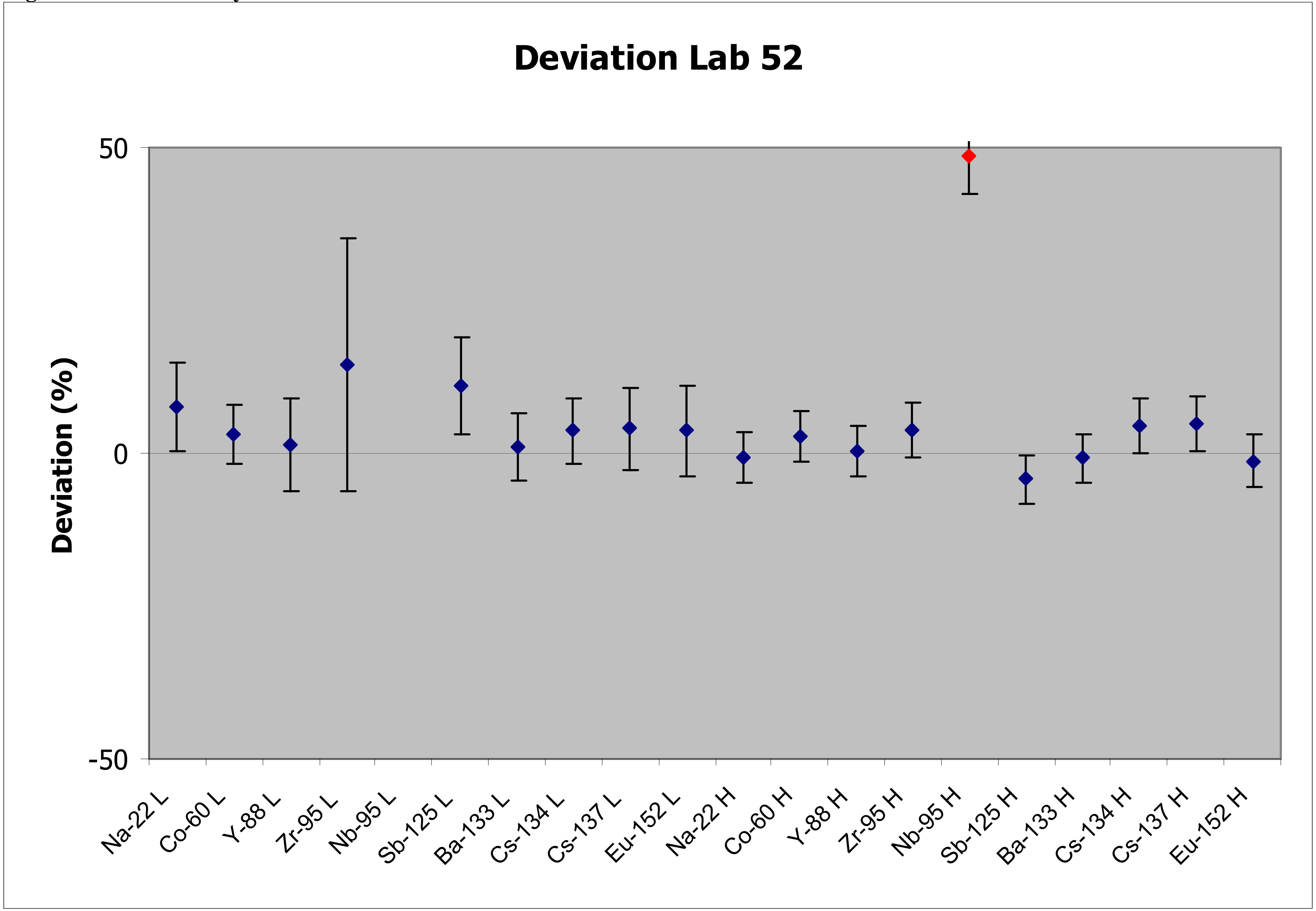


Figure 78 – Laboratory 53

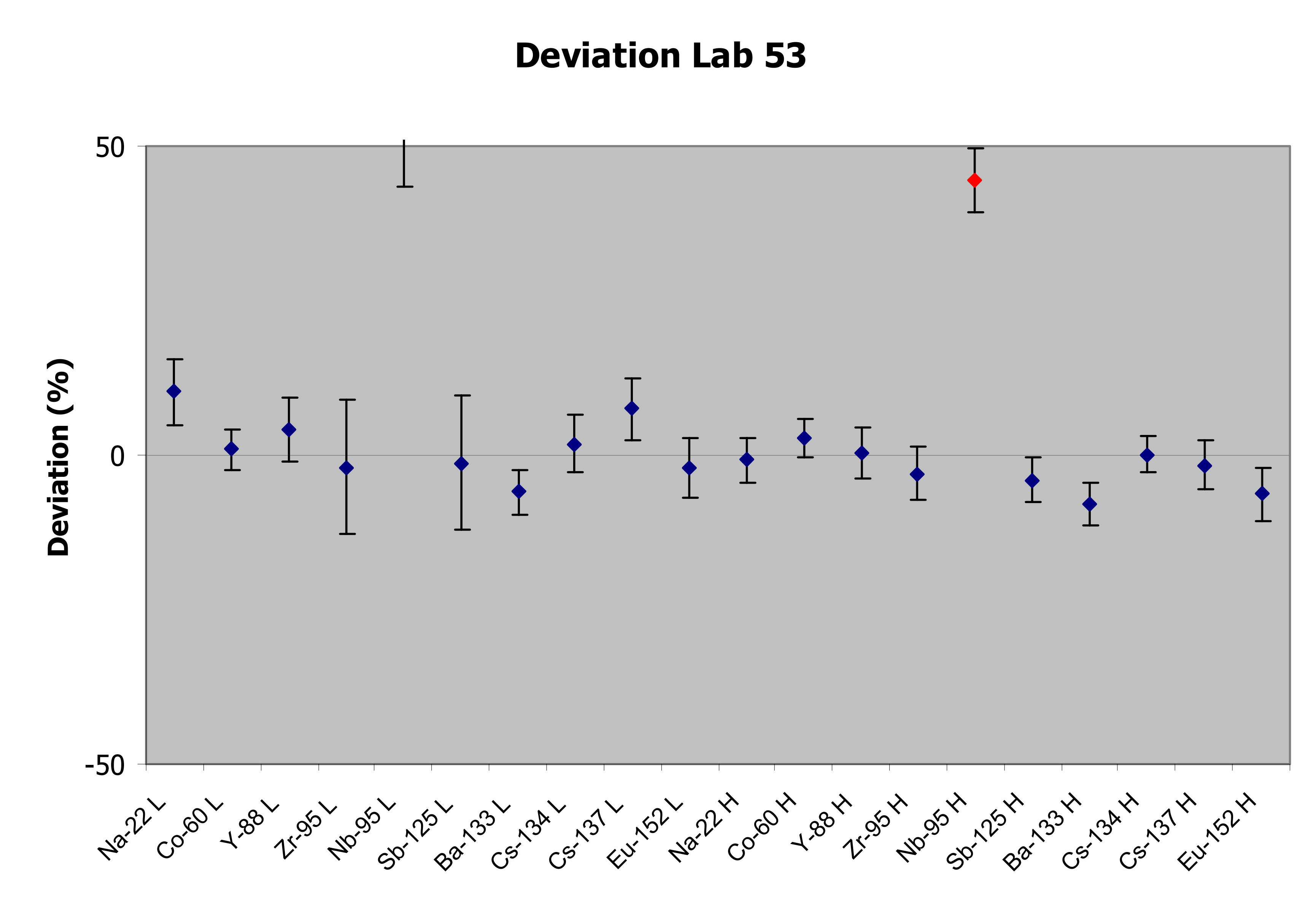


Figure 79 – Laboratory 54

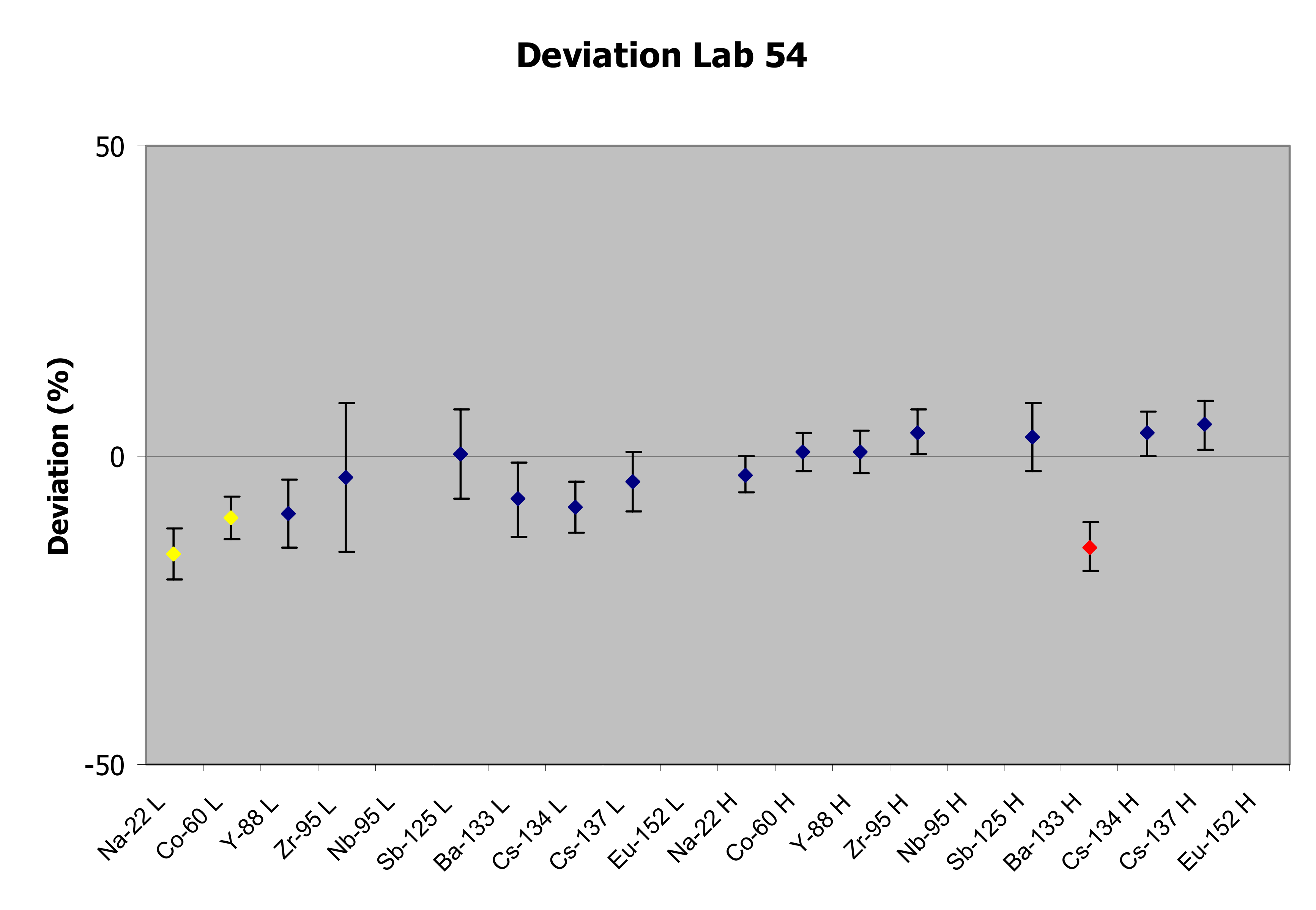


Figure 80 – Laboratory 55

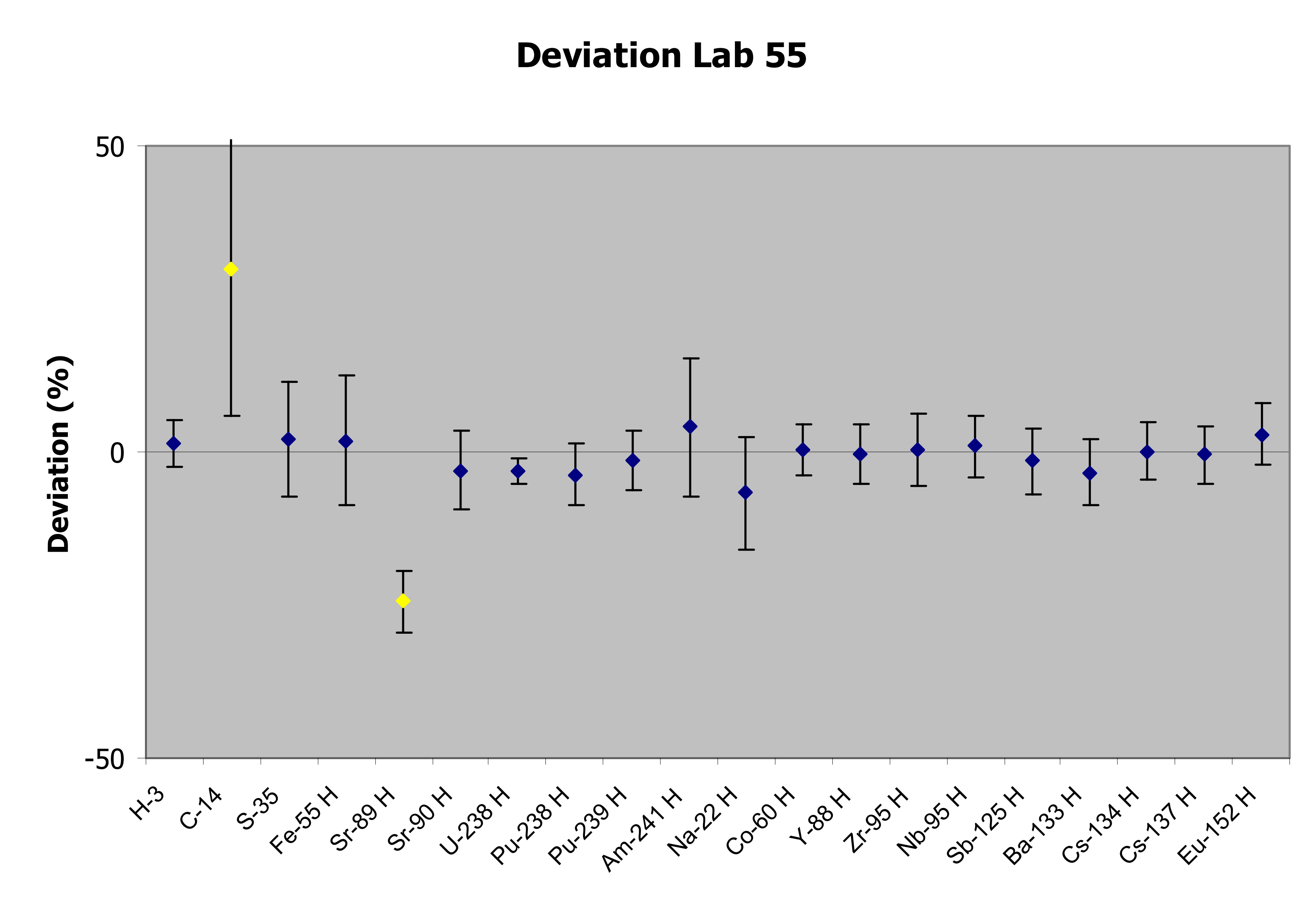


Figure 81 – Laboratory 56

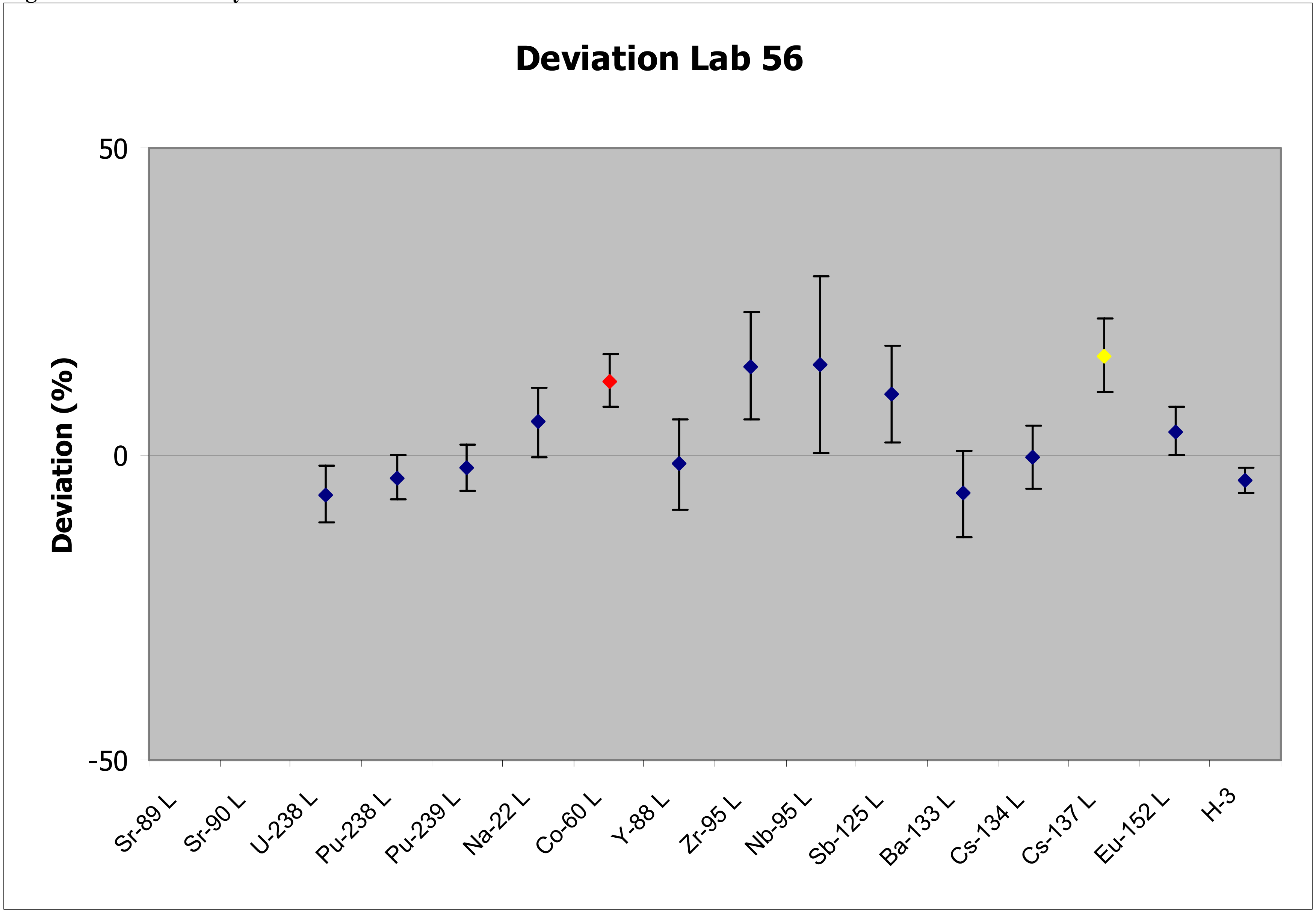


Figure 82 – Laboratory 57

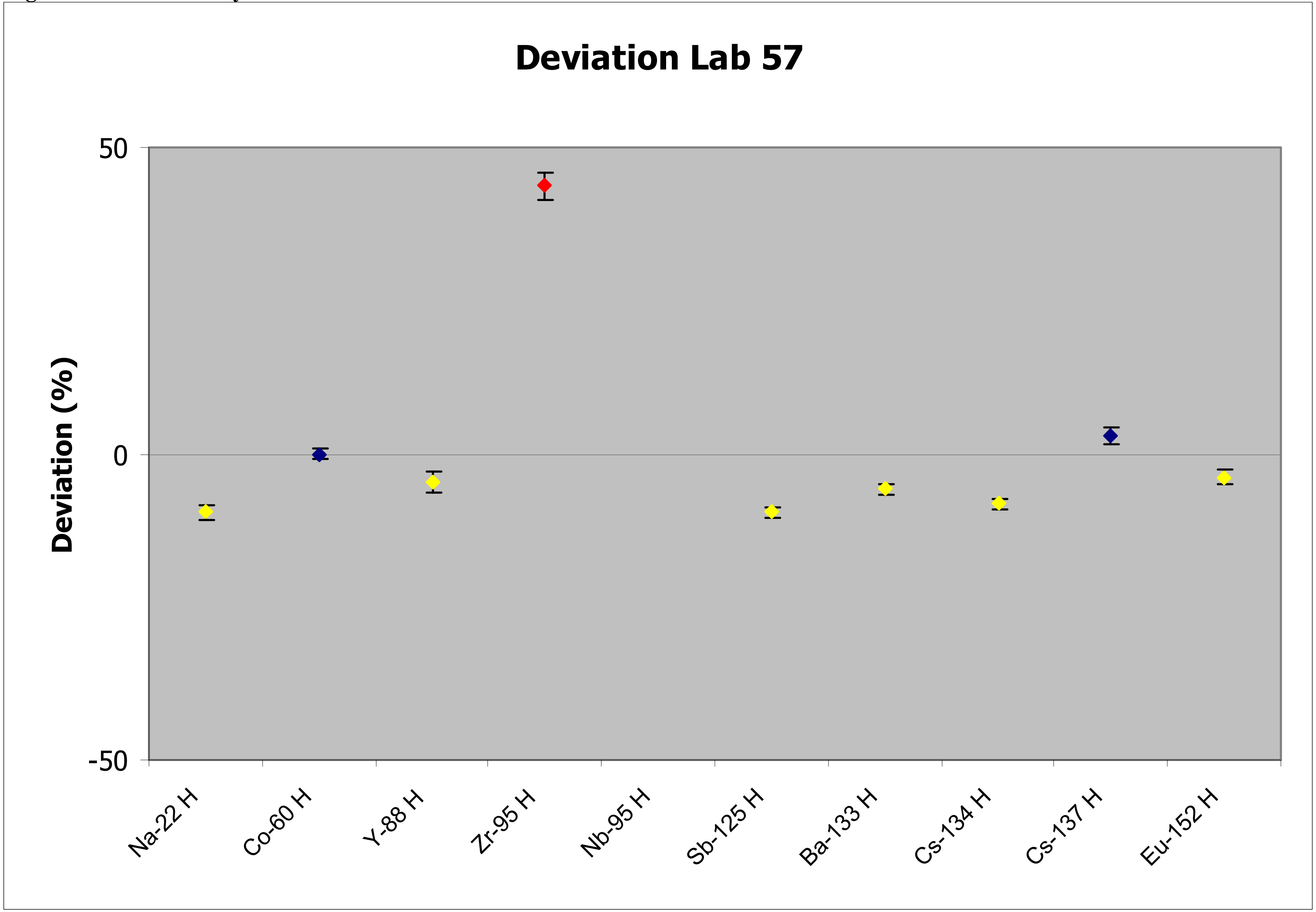


Figure 83 – Laboratory 58

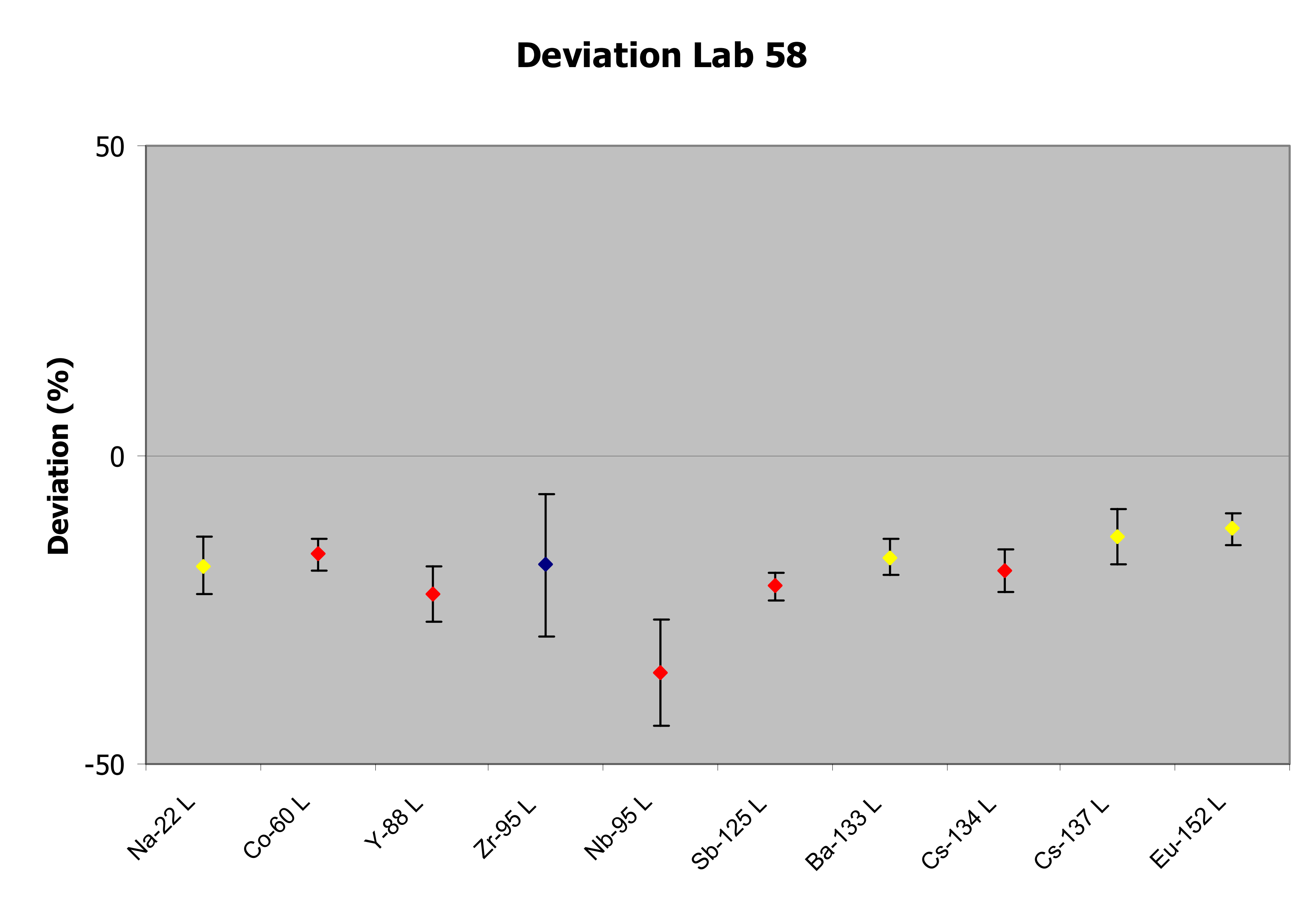


Figure 84 – Laboratory 59

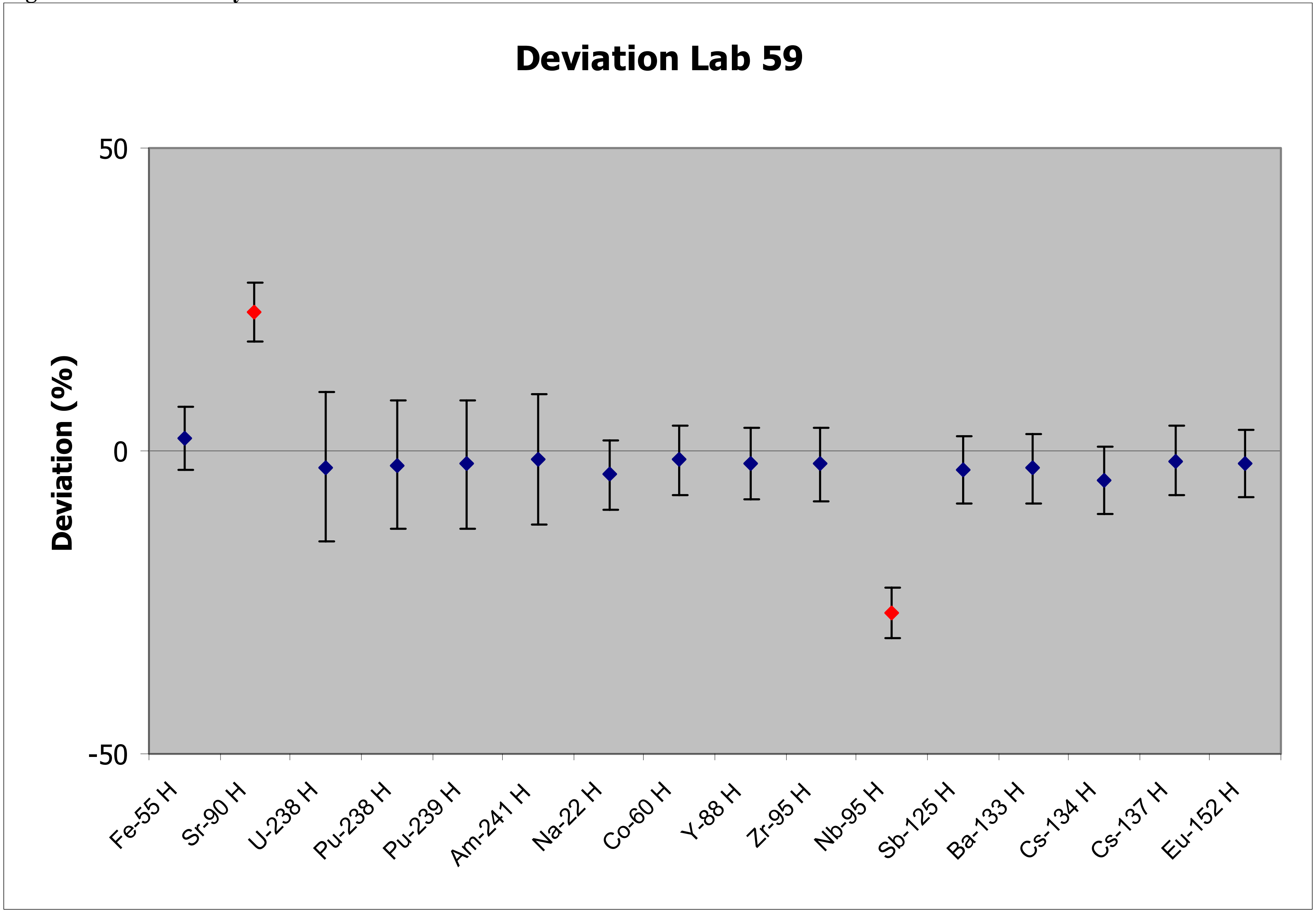


Figure 85 – Laboratory 60

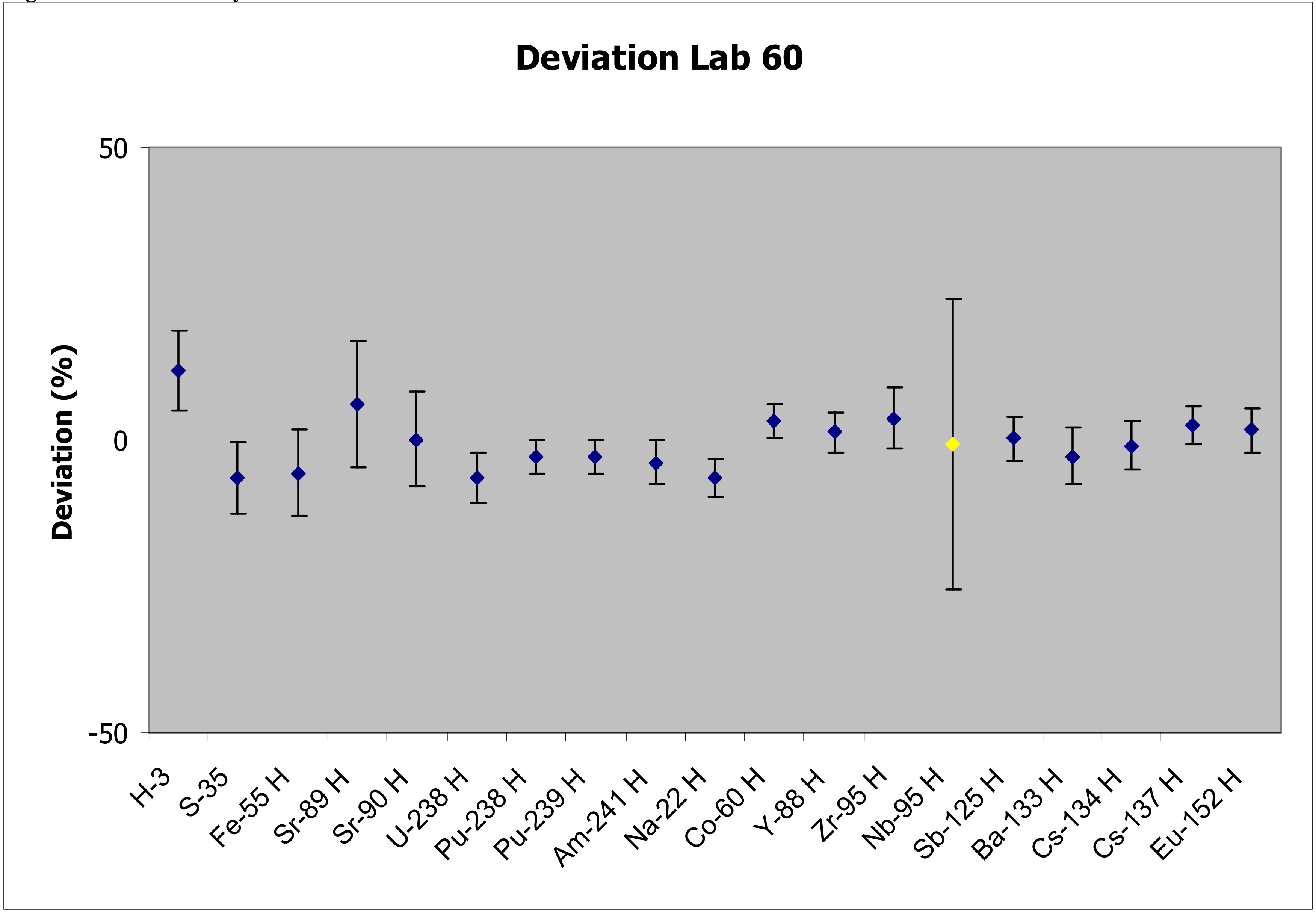


Figure 86 – Laboratory 61

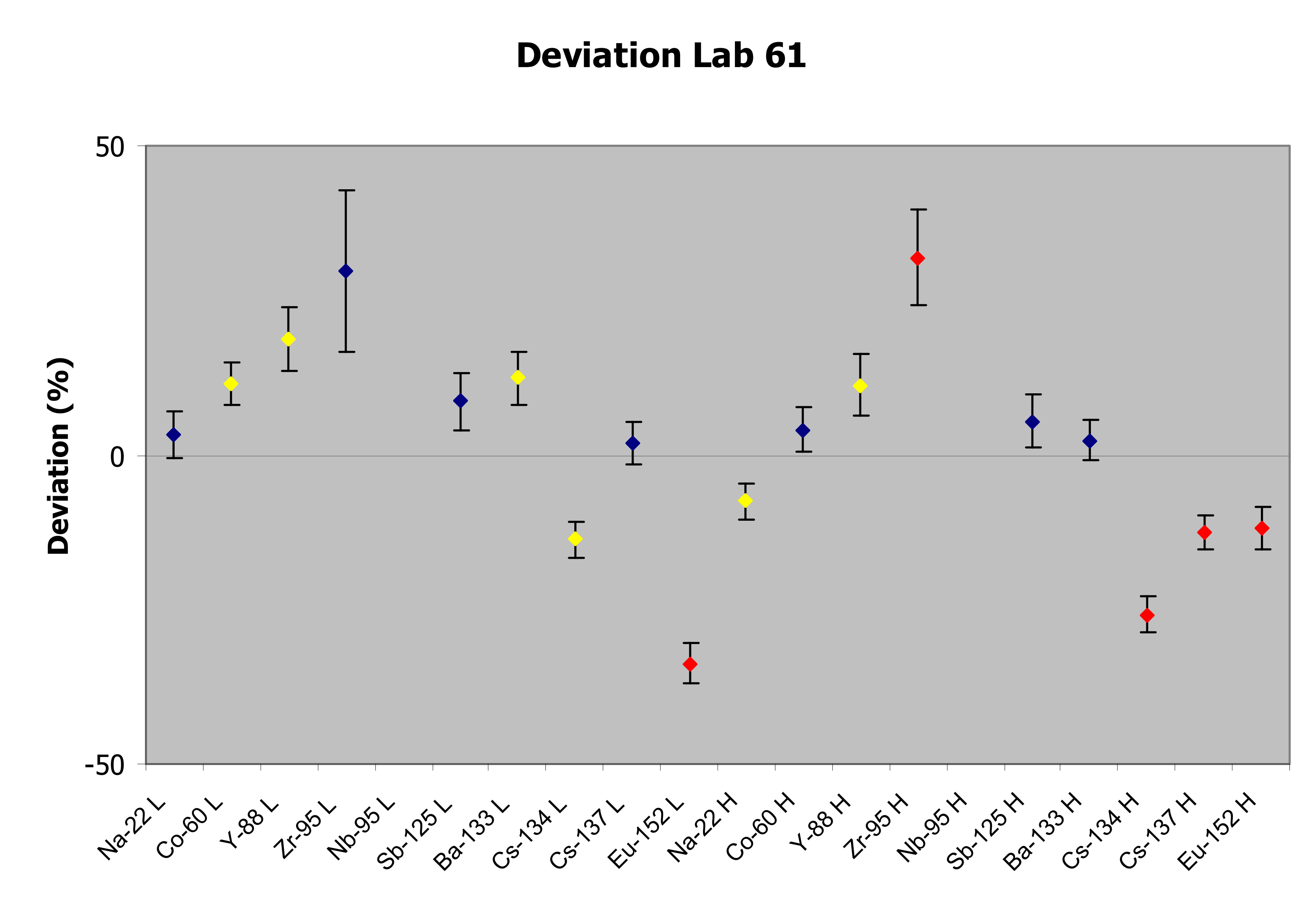


Figure 87 – Laboratory 62

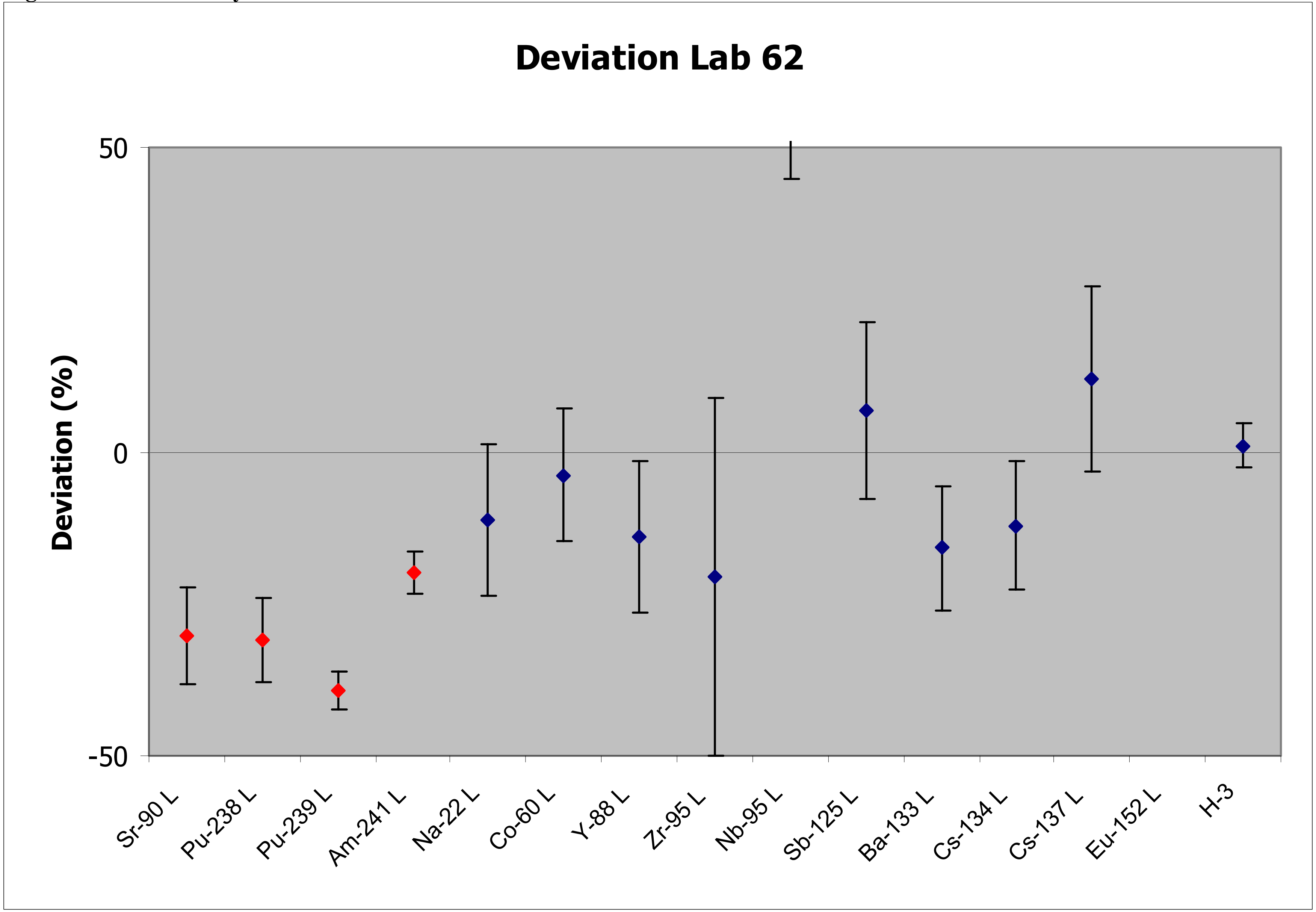


Figure 88 – Laboratory 63

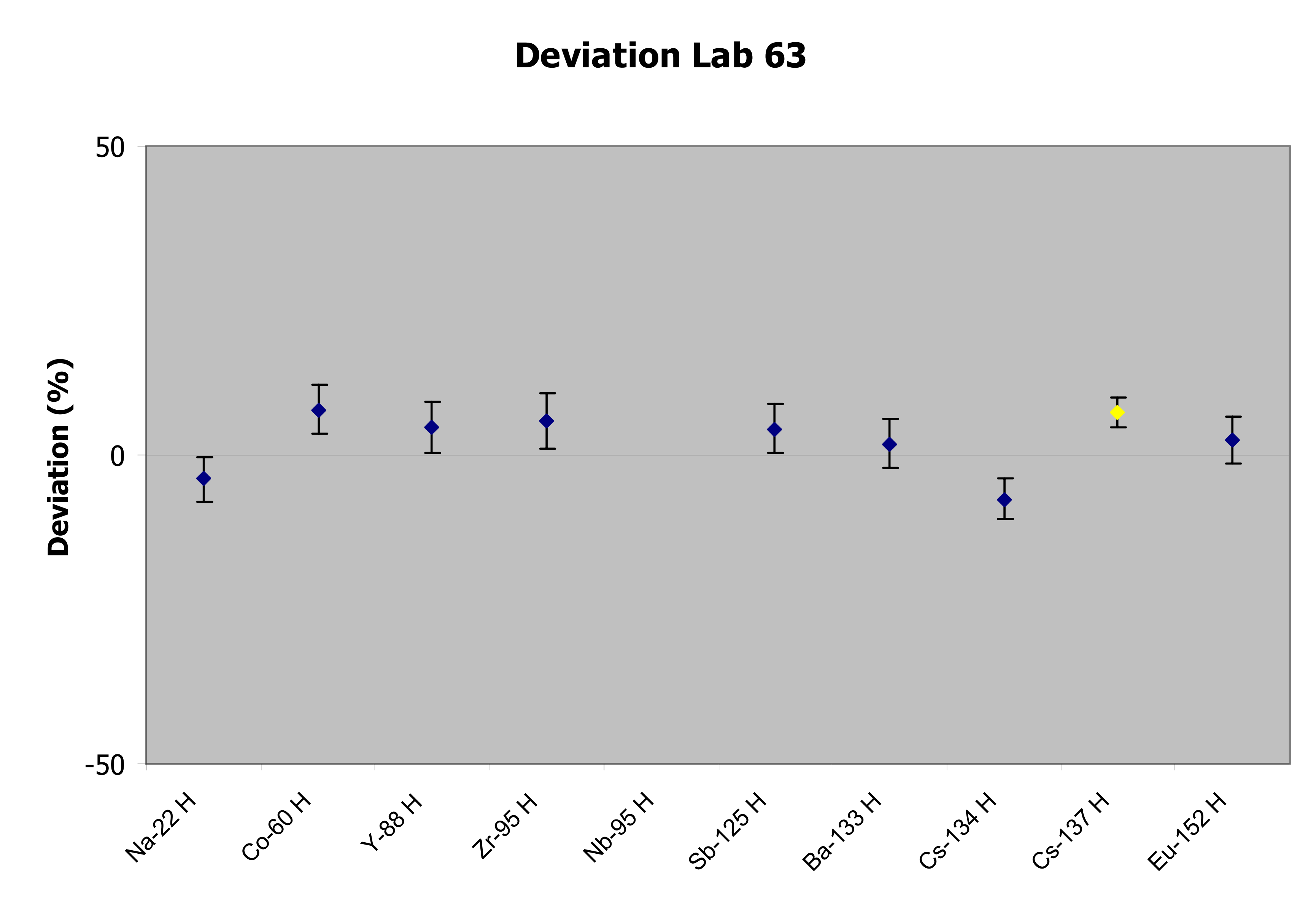
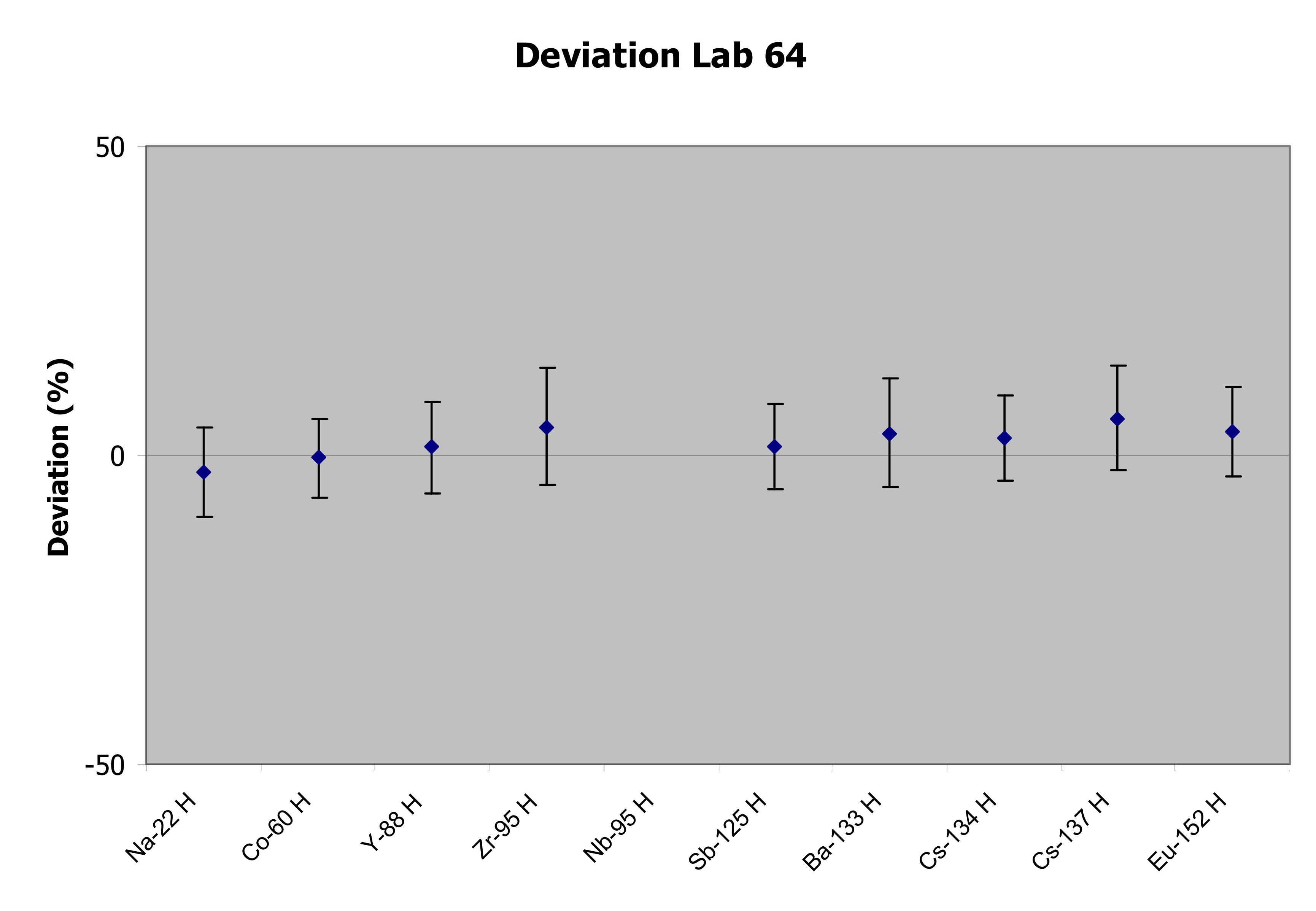


Figure 89 – Laboratory 64



Appendix A. Results sorted by nuclide

Table A1 – Fe-55 ABL **assigned result 15.8(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
34	15.2(13)	-0.49	-0.49	-4(9)
7	18(6) Q	0.34	1.46	1(4) × 10^{1}
21	17.9(11)	1.82	1.52	13(7)
28	18.8(16)	1.83	2.18	19(10)

Table A2 – Sr-89 ABL **assigned result 17.8(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	2.3(4)	-33.75 D	-7.09 D	-87.2(20)
35	13.6(6)	-6.12 Q	-1.95	-24(4)
22 M	16.0(20)	-0.91	-0.83	-10(11)
22 E	16(5)	-0.34	-0.71	-1(3) × 10^{1}
21	17.1(19)	-0.39	-0.35	-4(11)

Table A3 – Sr-90 ABL **assigned result 8.900(19) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	1.74(14)	-50.68 D	-10.00 D	-80.4(16)
35	5.65(17)	-19.00 D	-4.54 D	-36.5(19)
62	6.2(7)	-3.86 D	-3.77 D	-30(8)
25	7.2(6)	-2.79 Q	-2.37	-19(7)
22 M	7.5(9)	-1.67	-2.00	-16(10)
22 E	7.6(18) Q	-0.72	-1.77	-14(20)
8	8.5(3)	-1.60	-0.61	-5(3)
28	9.1(5)	0.46	0.29	2(5)
29	9.2(4)	0.75	0.42	3(5)
21	9.3(8)	0.55	0.61	5(9)
40	14(3)	1.83	6.70 Q	5(3) × 10^{1}
13	14.2(6)	8.83 D	7.40 D	60(7)
7	17.5(11)	7.61 D	12.00 D	97(13)

Table A4 – U-238 ABL **assigned result 1.24(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
29	1.04(5)	-3.47 Q	-2.46	-16(5)
22	1.15(10)	-0.88	-1.12	-7(8)
13	1.15(8)	-1.08	-1.12	-7(7)
47 M	1.15(5)	-1.47	-1.07	-7(5)
56	1.16(5)	-1.41	-1.00	-7(5)
47 A	1.17(12)	-0.58	-0.88	-6(10)
17	1.19(8)	-0.61	-0.63	-4(7)
34	1.21(6)	-0.48	-0.39	-3(6)
8 A	1.21(5)	-0.62	-0.39	-3(4)
4	1.25(9)	0.09	0.10	1(8)
40	1.26(8)	0.20	0.22	1(7)
35	1.31(4)	1.30	0.78	5(4)
8 M	1.340(20)	2.73 Q	1.19	8(3)
25	1.47(21)	1.07	2.81 Q	19(17)
28	1.5(7)	0.37	2.89 Q	$2(5) \times 10^1$

Table A5 – Pu-238 ABL **assigned result 15.28(5) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
62	10.5(10)	-4.55 D	-6.26 D	-31(7)
19	12.0(5)	-6.52 D	-4.33 D	-21(4)
28	13.0(13)	-1.73	-2.97 Q	-15(9)
29	14.3(8)	-1.22	-1.29	-6(5)
25	14.6(11)	-0.66	-0.94	-5(7)
56	14.7(6)	-1.01	-0.76	-4(4)
41	14.8(6)	-0.91	-0.70	-3(4)
35	14.8(5)	-1.06	-0.66	-3(3)
40	14.8(4)	-1.21	-0.63	-3(3)
4	15.2(5)	-0.17	-0.10	-1(3)
22	15.3(13)	-0.01	-0.02	0(9)
13	15.4(7)	0.17	0.16	1(5)
8	15.5(13)	0.17	0.29	1(8)
34	15.6(8)	0.40	0.42	2(5)
47	15.9(8)	0.82	0.82	4(5)
17	16.9(10)	1.57	2.08	10(7)

Table A6 – Pu-239 ABL **assigned result 13.29(6) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
62	8.1(4)	-12.60 D	-8.57 D	-39(3)
19	8.6(3)	-15.33 D	-7.70 D	-35.3(23)
25	12.8(9)	-0.52	-0.80	-4(7)
40	12.9(4)	-1.14	-0.64	-3(3)
56	13.0(5)	-0.56	-0.48	-2(4)
22	13.0(11)	-0.22	-0.41	-2(9)
29	13.1(6)	-0.31	-0.31	-1(5)
47	13.2(6)	-0.10	-0.10	0(5)
41	13.3(5)	-0.07	-0.06	0(4)
8	13.3(11)	0.01	0.02	0(8)
4	13.3(6)	0.02	0.02	0(4)
13	13.3(6)	0.02	0.02	0(5)
34	13.5(7)	0.30	0.35	2(6)
26	13.8(5)	0.98	0.82	4(4)
35	14.0(5)	1.48	1.10	5(4)
17	14.5(9)	1.41	1.97	9(7)
28	15.7(9)	2.74 D	3.88 D	18(7)

Table A7 – Am-241 ABL **assigned result 11.99(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
62	9.6(4)	-5.80 D	-3.98 D	-20(4)
47	11.7(10)	-0.26	-0.43	-2(8)
41	11.8(5)	-0.46	-0.35	-2(4)
25	11.9(7)	-0.08	-0.10	0(6)
22	12.0(10)	0.01	0.02	0(8)
13	12.1(6)	0.19	0.19	1(5)
17	12.1(7)	0.17	0.20	1(6)
28	12.2(17)	0.13	0.35	2(14)
21	12.4(4)	1.03	0.69	3(4)
42	12.9(15)	0.59	1.46	7(12)
4	12.9(7)	1.41	1.52	8(6)
40	12.9(4)	2.82 Q	1.52	8(3)
29	13.0(6)	1.68	1.69	8(5)
34	13.4(7)	2.01	2.36	12(6)
26	29.7(9)	19.02 D	29.54 D	148(8)

Table A8 – Fe-55 ABH **assigned result 6.89(12) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
7	5.1(9)	-1.95	-3.42 Q	-26(13)
38	6.4(3)	-1.85	-1.00	-8(4)
60	6.5(5)	-0.76	-0.73	-6(8)
55	7.0(7)	0.18	0.24	2(11)
59	7.0(4)	0.39	0.27	2(6)
32	7.7(6)	1.26	1.45	11(9)
21	8.0(5)	2.16	2.10	16(8)

Table A9 – Sr-89 ABH **assigned result 12.83(20) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
22 M	9.4(10)	-3.43 D	-2.81 D	-27(8)
55	9.7(6)	-4.82 Q	-2.57	-24(5)
38	11.0(5)	-3.39 Q	-1.50	-14(4)
22 E	13(3)	0.06	0.14	1(22)
60	13.6(14)	0.56	0.63	6(11)
32	14.4(13)	1.20	1.29	12(10)

Table A10 – Sr-90 ABH **assigned result 10.189(16) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
49	9.0(7)	-1.93	-1.70	-12(6)
22 E	9.0(19) Q	-0.65	-1.69	-12(19)
22 M	9.3(8)	-1.25	-1.29	-9(7)
38	9.43(22)	-3.44 Q	-1.04	-7.4(22)
55	9.9(7)	-0.47	-0.43	-3(7)
32	10.1(9)	-0.09	-0.11	-1(9)
60	10.2(8)	0.01	0.02	0(8)
28	11.3(13)	0.85	1.53	11(13)
36	11.6(5)	2.74 Q	1.88	13(5)
14	11.6(5)	3.00 Q	1.98	14(5)
8	12.0(13)	1.35	2.49	18(13)
59	12.5(5)	4.65 D	3.20 D	23(5)
7	17.9(9)	8.68 D	10.52 D	75(9)

Table A11 – U-238 ABH **assigned result 1.059(24) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
28	0.92(4)	-3.37 D	-3.02 D	-13(4)
47	0.97(5)	-1.72	-1.98	-9(5)
60	0.99(4)	-1.49	-1.45	-7(5)
17	1.01(5)	-0.88	-1.03	-5(5)
55	1.0260(10)	-1.37	-0.69	-3.1(22)
38	1.03(9)	-0.31	-0.61	-3(9)
21	1.03(4)	-0.62	-0.61	-3(5)
22	1.03(8)	-0.35	-0.61	-3(8)
59	1.03(13)	-0.22	-0.61	-3(12)
32	1.04(4)	-0.38	-0.36	-2(5)
8 A	1.07(3)	0.28	0.23	1(4)
4 A	1.10(10)	0.40	0.87	4(10)
4 G	1.10(19)	0.22	0.87	4(18)
8 M	1.26(3)	5.58 D	4.24 D	19(4)

Table A12 – Pu-238 ABH **assigned result 2.607(9) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
49	1.52(5)	-20.99 D	-7.87 D	-41.7(20)
28	2.5(3)	-0.42	-0.92	-5(12)
55	2.51(13)	-0.74	-0.69	-4(5)
60	2.53(8)	-1.01	-0.56	-3(3)
59	2.5(3)	-0.21	-0.43	-2(11)
47	2.57(9)	-0.38	-0.24	-1(4)
22	2.58(22)	-0.12	-0.20	-1(9)
38	2.77(9)	1.80	1.18	6(4)
4	2.80(8)	2.28	1.40	7(4)
32	2.81(11)	1.84	1.47	8(5)
17	2.91(16)	1.89	2.19	12(6)
8	3.0(3)	1.39	2.70 Q	14(10)
14	3.5(3)	3.23 D	6.32 D	33(10)
21	14(3)	4.38 D	82.49 D	44(10) $\times 10^1$

Table A13 – Pu-239 ABH **assigned result 6.06(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
49	4.0(4)	-5.01 D	-6.25 D	-34(7)
28	5.3(4)	-1.87	-2.28	-12(7)
22	5.8(5)	-0.62	-0.85	-5(8)
14	5.8(5)	-0.51	-0.67	-4(7)
60	5.89(18)	-0.95	-0.52	-3(3)
59	5.9(7)	-0.21	-0.41	-2(11)
55	6.0(3)	-0.27	-0.24	-1(5)
47	6.1(3)	-0.04	-0.03	0(5)
4	6.10(24)	0.16	0.12	1(4)
38	6.39(13)	2.47	1.00	5.4(22)
32	6.46(24)	1.65	1.21	7(4)
17	6.8(4)	1.99	2.24	12(6)
8	6.9(6)	1.42	2.51	14(10)

Table A14 – Am-241 ABH **assigned result 3.691(13) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
14	2.68(21)	-4.80 D	-5.42 D	-27(6)
60	3.55(14)	-0.99	-0.75	-4(4)
38	3.57(18)	-0.67	-0.65	-3(5)
8 X2	3.62(16)	-0.46	-0.38	-2(5)
32	3.63(11)	-0.55	-0.33	-2(3)
59	3.6(4)	-0.13	-0.28	-1(11)
22	3.7(3)	0.00	0.00	0(8)
8 L	3.71(15)	0.13	0.10	1(4)
8 X1	3.73(16)	0.24	0.21	1(5)
28	3.75(20)	0.30	0.32	2(6)
17	3.76(19)	0.36	0.37	2(5)
21	3.76(19)	0.76	0.37	1.9(25)
55	3.8(4)	0.35	0.79	4(11)
4 G	4.0(7)	0.48	1.66	8(17)
47	4.0(5)	0.72	1.69	9(12)
4 A	4.10(12)	3.31 Q	2.20	11(4)
8 A	4.3(4)	1.73	3.27 Q	17(10)

Table A15 – Na-22 GL **assigned result 3.718(14) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	2.0(3)	-5.72 D	-5.30 D	-46(8)
27	2.7(8)	-1.27	-3.14 Q	-27(22)
58	3.05(17)	-3.91 Q	-2.06	-18(5)
40	3.1(7)	-0.89	-2.00	-17(20)
47	3.1(3)	-2.17	-1.87	-16(8)
54	3.12(15)	-3.97 Q	-1.84	-16(4)
21	3.15(13)	-4.34 Q	-1.75	-15(4)
10	3.3(6)	-0.76	-1.32	-12(15)
29	3.3(3)	-1.39	-1.29	-11(8)
19	3.30(15)	-2.77 Q	-1.29	-11(4)
62	3.3(5)	-0.91	-1.29	-11(12)
41	3.3(5)	-0.86	-1.26	-11(13)
28	3.3(3)	-1.42	-1.23	-11(8)
35	3.3(4)	-0.95	-1.23	-11(11)
34	3.3(4)	-1.11	-1.16	-10(9)
13	3.34(18)	-2.09	-1.16	-10(4)
5	3.4(4)	-0.99	-1.04	-9(9)
32	3.41(15)	-2.04	-0.95	-8(4)
45	3.4(5)	-0.61	-0.95	-8(13)
51	3.50(20)	-1.09	-0.67	-6(6)
24	3.5(4)	-0.58	-0.64	-6(10)
8	3.54(23)	-0.77	-0.55	-5(6)
17	3.6(4)	-0.30	-0.39	-3(11)
46	3.70(21)	-0.08	-0.05	0(6)
42	3.7(6)	0.04	0.07	1(16)
61	3.84(14)	0.87	0.38	3(4)
56	3.91(21)	0.91	0.59	5(6)
18	4.00(20)	1.41	0.87	8(6)
52	4.0(3)	1.04	0.87	8(7)
53	4.10(20)	1.91	1.18	10(6)

Table A16 – Co-60 GL **assigned result 18.84(6) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	11.6(4)	-17.89 D	-8.60 D	-38.4(21)
27	14(3)	-1.70	-5.87 Q	-26(15)
58	15.8(5)	-6.28 D	-3.61 D	-16(3)
54	16.9(6)	-3.03 Q	-2.28	-10(4)
4	17.00(17)	-10.19 Q	-2.18	-9.8(10)
17	17.2(8)	-2.11	-1.93	-9(4)
10	17.2(8)	-2.08	-1.91	-9(4)
45	17.6(12)	-1.09	-1.51	-7(6)
15	17.9(13)	-0.71	-1.11	-5(7)
46	18.1(8)	-0.85	-0.85	-4(5)
62	18.1(21)	-0.35	-0.85	-4(11)
47	18.1(9)	-0.75	-0.84	-4(5)
19	18.6(6)	-0.39	-0.28	-1(4)
13	18.7(7)	-0.25	-0.20	-1(4)
8	18.8(8)	-0.05	-0.04	0(5)
32	18.9(4)	0.06	0.03	0.1(19)
41	18.9(7)	0.08	0.06	0(4)
28	19.0(10)	0.16	0.19	1(6)
21	19.0(5)	0.32	0.19	1(3)
53	19.0(6)	0.27	0.19	1(4)
24	19.3(8)	0.63	0.56	3(4)
52	19.4(9)	0.62	0.67	3(5)
5	19.4(19)	0.30	0.69	3(10)
40	20(5)	0.16	0.91	4(25)
51	19.7(10)	0.86	1.02	5(6)
35	19.8(8)	1.30	1.14	5(4)
29	19.8(15)	0.64	1.14	5(8)
34	19.9(20)	0.53	1.26	6(11)
18	19.9(6)	1.76	1.26	6(4)
7	20(3)	0.51	1.86	8(16)
42	20.6(22)	0.80	2.09	9(12)
61	21.0(7)	3.36 Q	2.57	11(4)
56	21.1(8)	2.82 D	2.69 D	12(5)

Table A17 – Y-88 GL **assigned result 3.843(14) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	2.6(3)	-4.14 D	-4.37 D	-32(8)
27	2.7(7)	-1.63	-4.02 Q	-30(18)
58	2.98(17)	-5.06 D	-3.03 D	-22(5)
62	3.3(5)	-1.13	-1.91	-14(12)
54	3.48(21)	-1.73	-1.28	-9(6)
10	3.5(7)	-0.50	-1.21	-9(18)
5	3.6(4)	-0.79	-0.99	-7(9)
17	3.6(5)	-0.48	-0.85	-6(13)
41	3.7(8)	-0.24	-0.64	-5(20)
35	3.8(4)	-0.22	-0.29	-2(10)
56	3.8(3)	-0.23	-0.22	-2(7)
13	3.8(3)	-0.20	-0.19	-1(7)
19	3.80(20)	-0.22	-0.15	-1(5)
47	3.83(25)	-0.05	-0.05	0(7)
24	3.86(22)	0.08	0.06	0(6)
28	3.9(3)	0.20	0.20	1(7)
52	3.9(3)	0.20	0.20	1(8)
15	4.0(13)	0.09	0.41	3(40)
45	4.0(6)	0.28	0.52	4(14)
29	4.0(4)	0.39	0.55	4(10)
53	4.00(20)	0.78	0.55	4(5)
40	4.0(10)	0.17	0.59	4(25)
34	4.0(4)	0.49	0.69	5(10)
21	4.10(10)	2.54	0.90	7(3)
32	4.12(14)	1.97	0.97	7(4)
51	4.20(20)	1.78	1.25	9(5)
18	4.20(20)	1.78	1.25	9(5)
46	4.2(3)	1.36	1.29	10(7)
42	4.3(6)	0.82	1.64	12(15)
61	4.56(20)	3.58 Q	2.52	19(5)
8	4.8(3)	2.92 D	3.19 D	24(8)

Table A18 – Zr-95 GL **assigned result 1.836(19) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
27	1.0(5)	-1.67	-3.27 Q	-5(3) × 10^{1}
23	1.2(3)	-2.12	-2.49	-35(16)
62	1.5(6)	-0.70	-1.47	-2(3) × 10^{1}
58	1.51(21)	-1.55	-1.28	-18(11)
47	1.69(21)	-0.69	-0.57	-8(11)
29	1.7(3)	-0.45	-0.53	-7(16)
19	1.70(20)	-0.68	-0.53	-7(11)
54	1.77(22)	-0.30	-0.26	-4(12)
28	1.8(3)	-0.20	-0.22	-3(15)
53	1.80(20)	-0.18	-0.14	-2(11)
40	1.9(5)	0.08	0.13	2(25)
24	1.87(23)	0.15	0.13	2(13)
21	1.90(20)	0.32	0.25	3(11)
8	1.9(3)	0.25	0.29	4(16)
15	1.9(20) Q	0.04	0.29	0(11) × 10^{1}
18	1.94(12)	0.86	0.41	6(7)
51	2.1(3)	0.88	1.03	14(16)
56	2.10(16)	1.64	1.03	14(9)
52	2.1(4)	0.69	1.03	14(21)
32	2.14(19)	1.59	1.19	17(10)
34	2.31(25)	1.89	1.86	26(14)
61	2.38(24)	2.26	2.13	30(13)
46	2.5(4)	1.98	2.48	35(17)
42	2.5(5)	1.40	2.52	35(25)
13	2.5(4)	1.68	2.64 Q	37(22)
10	2.6(11)	0.63	2.80 Q	4(6) × 10^{1}
5	3.9(4)	5.26 D	8.05 D	112(21)

Table A19 – Nb-95 GL **assigned result 3.84(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
10	0.0(13)	-2.86 D	-7.90 D	-100(0)
58	2.5(4)	-4.08 D	-2.79 D	-35(9)
23	2.5(4)	-3.32 D	-2.75 D	-35(10)
27	2.6(7)	-1.76	-2.54	-32(18)
13	2.7(8)	-1.49	-2.34	-30(20)
45	3.4(4)	-1.06	-0.88	-11(10)
47	3.43(19)	-2.09	-0.83	-11(5)
32	3.86(13)	0.18	0.05	1(4)
35	3.9(5)	0.13	0.13	2(13)
29	3.9(6)	0.11	0.13	2(16)
18	4.00(16)	1.00	0.34	4(5)
7	4.0(11)	0.16	0.34	4(30)
21	4.00(19)	0.85	0.34	4(5)
42	4.2(6)	0.57	0.69	9(15)
28	4.2(4)	1.07	0.71	9(9)
56	4.4(6)	1.02	1.16	15(14)
51	4.7(10)	0.86	1.78	$2(3) \times 10^1$
40	5.3(13)	1.17	3.06 Q	$4(4) \times 10^1$
8	5.9(14)	1.49	4.21 Q	$5(4) \times 10^1$
53	6.1(6)	3.77 D	4.66 D	59(16)
54	6.4(4)	6.81 D	5.22 D	66(10)
52	6.5(4)	6.47 D	5.49 D	69(11)
62	6.6(10)	2.70 D	5.61 D	$7(3) \times 10^1$
15	7(3)	1.05	5.78 Q	$7(7) \times 10^1$
5	6.9(7)	4.43 D	6.31 D	80(18)
19	6.9(3)	10.13 D	6.31 D	80(8)
41	8.7(20)	2.45	10.06 Q	$13(5) \times 10^1$
61	9.0(4)	12.85 D	10.64 D	135(11)

Table A20 – Sb-125 GL **assigned result 6.48(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
13	3.8(4)	-7.64 D	-5.54 D	-42(6)
23	4.0(3)	-8.20 D	-5.10 D	-38(5)
41	5.0(12)	-1.23	-2.96 Q	-22(18)
58	5.10(15)	-8.89 D	-2.84 D	-21.3(24)
27	5.6(16)	-0.55	-1.81	-14(25)
10	6.2(9)	-0.36	-0.64	-5(13)
47	6.2(4)	-0.71	-0.52	-4(6)
34	6.3(6)	-0.32	-0.41	-3(10)
24	6.3(4)	-0.34	-0.29	-2(7)
53	6.4(7)	-0.11	-0.17	-1(11)
19	6.4(3)	-0.27	-0.17	-1(5)
54	6.5(5)	0.02	0.02	0(7)
28	6.6(5)	0.20	0.18	1(7)
46	6.6(4)	0.28	0.25	2(7)
40	6.6(16)	0.09	0.31	2(25)
21	6.70(20)	1.08	0.45	3(4)
29	6.7(6)	0.37	0.45	3(9)
45	6.7(19)	0.14	0.53	0(3) × 10^{1}
5	6.8(7)	0.44	0.62	5(11)
51	6.8(3)	1.06	0.66	5(5)
62	6.9(9)	0.47	0.90	7(15)
32	7.0(3)	1.60	1.03	8(5)
18	7.02(23)	2.31	1.11	8(4)
61	7.0(3)	1.91	1.15	9(5)
56	7.1(5)	1.23	1.30	10(8)
42	7.2(9)	0.71	1.38	10(15)
52	7.2(5)	1.41	1.48	11(8)
8	7.3(5)	1.61	1.62	12(8)
35	7.6(9)	1.26	2.37	18(14)
15	7.8(25)	0.52	2.72 Q	2(4) × 10^{1}
17	8.5(11)	1.73	4.05 Q	30(18)

Table A21 – Ba-133 GL **assigned result 5.74(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	3.2(3)	-8.40 D	-6.77 D	-44(5)
4	4.00(21)	-8.15 D	-4.64 D	-30(4)
41	4.7(5)	-2.13	-2.85 Q	-19(9)
58	4.79(16)	-5.77 Q	-2.54	-17(3)
62	4.8(6)	-1.54	-2.43	-16(10)
13	5.0(3)	-2.57	-2.00	-13(5)
45	5.1(8)	-0.88	-1.76	-12(13)
35	5.1(4)	-1.66	-1.74	-11(7)
28	5.1(3)	-2.27	-1.71	-11(5)
42	5.2(6)	-0.95	-1.52	-10(10)
10	5.2(6)	-0.87	-1.39	-9(10)
54	5.3(4)	-1.20	-1.10	-7(6)
56	5.4(4)	-0.93	-0.99	-6(7)
17	5.4(4)	-1.03	-0.99	-6(7)
32	5.40(17)	-1.96	-0.91	-6(3)
29	5.4(5)	-0.68	-0.91	-6(9)
53	5.40(20)	-1.68	-0.91	-6(4)
34	5.4(7)	-0.43	-0.83	-5(13)
24	5.5(4)	-0.79	-0.78	-5(7)
47	5.45(23)	-1.25	-0.78	-5(4)
19	5.50(20)	-1.19	-0.64	-4(4)
40	5.6(13)	-0.13	-0.46	-3(23)
27	5.7(17)	-0.02	-0.11	$0(3) \times 10^1$
52	5.8(3)	0.18	0.15	1(6)
8	5.9(3)	0.42	0.34	2(6)
51	5.9(3)	0.52	0.42	3(6)
21	5.90(20)	0.77	0.42	3(4)
46	6.1(4)	1.11	0.95	6(6)
18	6.32(19)	2.98 Q	1.54	10(4)
61	6.46(24)	2.95 Q	1.91	12(5)
5	7.2(7)	2.05	3.93 Q	26(13)
7	7.5(19)	0.93	4.68 Q	$3(4) \times 10^1$

Table A22 – Cs-134 GL **assigned result 5.30(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	3.2(3)	-6.95 D	-6.84 D	-40(6)
27	3.3(7)	-2.86 D	-6.52 D	-38(13)
58	4.31(18)	-5.39 D	-3.23 D	-19(4)
10	4.6(3)	-2.54	-2.42	-14(6)
61	4.58(15)	-4.66 Q	-2.35	-14(3)
62	4.7(6)	-1.15	-2.09	-12(11)
28	4.8(4)	-1.72	-1.80	-10(6)
15	4.8(9)	-0.64	-1.77	-10(16)
19	4.80(15)	-3.24 Q	-1.64	-9(3)
54	4.86(22)	-1.98	-1.44	-8(5)
35	4.9(4)	-1.16	-1.21	-7(6)
32	4.96(13)	-2.52	-1.12	-6(3)
47	4.97(20)	-1.63	-1.08	-6(4)
4	5.00(20)	-1.49	-0.99	-6(4)
17	5.1(4)	-0.70	-0.76	-4(6)
42	5.1(6)	-0.38	-0.73	-4(11)
29	5.1(4)	-0.51	-0.66	-4(8)
34	5.2(3)	-0.33	-0.30	-2(6)
56	5.3(3)	-0.08	-0.08	0(5)
13	5.4(3)	0.15	0.15	1(6)
53	5.40(24)	0.40	0.32	2(5)
46	5.5(3)	0.52	0.48	3(6)
24	5.5(5)	0.35	0.54	3(9)
5	5.5(6)	0.32	0.58	3(10)
21	5.50(10)	1.83	0.64	3.7(20)
52	5.5(3)	0.70	0.64	4(6)
51	5.6(3)	0.98	0.97	6(6)
8	5.6(3)	1.08	1.06	6(6)
41	5.7(7)	0.51	1.13	7(13)
45	5.7(6)	0.58	1.16	7(12)
18	5.73(17)	2.44	1.39	8(4)
7	5.8(14)	0.36	1.58	$1(3) \times 10^1$
40	6.2(15)	0.59	2.85 Q	$2(3) \times 10^1$

Table A23 – Cs-137 GL **assigned result 2.884(20) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	1.90(20)	-4.90 D	-4.85 D	-34(7)
15	2.2(8)	-0.80	-3.23 Q	-2(3) × 10^1
45	2.4(3)	-1.78	-2.63 Q	-19(10)
58	2.50(13)	-2.92 Q	-1.89	-13(5)
7	2.6(12)	-0.22	-1.35	-1(5) × 10^1
42	2.7(5)	-0.44	-0.96	-7(15)
54	2.76(14)	-0.88	-0.61	-4(5)
47	2.87(21)	-0.07	-0.07	0(7)
27	2.9(9)	0.02	0.08	0(3) × 10^1
19	2.90(10)	0.15	0.08	1(4)
51	2.90(10)	0.15	0.08	1(4)
61	2.94(10)	0.55	0.28	2(4)
21	2.95(16)	0.41	0.32	2(6)
10	3.0(3)	0.27	0.37	3(10)
13	2.96(17)	0.44	0.37	3(6)
29	3.0(3)	0.39	0.57	4(10)
52	3.00(19)	0.61	0.57	4(7)
24	3.01(20)	0.63	0.62	4(7)
28	3.04(25)	0.62	0.77	5(9)
34	3.04(16)	0.97	0.77	5(6)
8	3.05(19)	0.87	0.82	6(7)
32	3.07(15)	1.23	0.92	6(6)
53	3.10(14)	1.53	1.06	7(5)
18	3.18(10)	2.90 Q	1.46	10(4)
17	3.2(5)	0.66	1.51	11(16)
35	3.2(4)	0.88	1.66	12(13)
62	3.2(5)	0.79	1.70	12(15)
46	3.26(22)	1.70	1.85	13(8)
56	3.35(17)	2.72 Q	2.30	16(6)
40	3.4(8)	0.60	2.39	2(3) × 10^1
41	3.4(6)	0.84	2.54	18(21)
5	4.1(4)	2.94 D	5.94 D	42(14)

Table A24 – Eu-152 GL **assigned result 4.19(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
23	2.1(3)	-6.94 D	-6.11 D	-50(7)
27	2.1(7)	-2.99 D	-6.11 D	-50(17)
61	2.78(13)	-10.59 D	-4.12 D	-34(3)
17	3.2(5)	-2.08	-2.98 Q	-24(12)
10	3.2(5)	-2.11	-2.78 Q	-23(11)
28	3.3(3)	-2.96 Q	-2.52	-21(7)
19	3.60(20)	-2.93 Q	-1.73	-14(5)
35	3.7(5)	-1.13	-1.55	-13(11)
58	3.69(11)	-4.41 Q	-1.47	-12(3)
34	3.7(4)	-1.32	-1.47	-12(9)
45	3.7(8)	-0.61	-1.44	-12(19)
13	3.8(4)	-1.20	-1.23	-10(8)
24	4.0(3)	-0.82	-0.65	-5(7)
46	4.02(25)	-0.69	-0.50	-4(6)
47	4.1(3)	-0.51	-0.39	-3(6)
53	4.10(20)	-0.46	-0.27	-2(5)
51	4.20(20)	0.03	0.02	0(5)
21	4.30(20)	0.53	0.31	3(5)
29	4.3(4)	0.27	0.31	3(10)
56	4.35(16)	0.96	0.46	4(4)
52	4.4(3)	0.50	0.46	4(8)
18	4.50(20)	1.52	0.90	7(5)
8	4.6(7)	0.59	1.10	9(15)
32	4.8(4)	1.48	1.68	14(9)
15	5.8(16)	1.06	4.80 Q	4(4) × 10^1

Table A25 – Na-22 GH **assigned result 2.498(9) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
25	1.24(9)	-13.91 D	-13.43 D	-50(4)
48	1.950(20)	-25.00 D	-5.85 D	-21.9(9)
21	2.03(5)	-9.22 D	-5.00 D	-18.7(20)
47	2.1(3)	-1.53	-4.25 Q	-16(10)
13	2.13(7)	-5.22 D	-3.93 D	-15(3)
17	2.17(8)	-4.08 D	-3.50 D	-13(4)
4	2.2(3)	-1.15	-3.18 Q	-12(10)
49	2.22(12)	-2.31	-2.97 Q	-11(5)
8	2.22(9)	-3.08 D	-2.97 D	-11(4)
14	2.23(11)	-2.43	-2.86 Q	-11(5)
5	2.26(23)	-1.04	-2.54	-10(9)
57	2.26(3)	-7.61 Q	-2.54	-9.5(12)
36	2.28(4)	-5.32 Q	-2.33	-8.7(16)
28	2.28(12)	-1.81	-2.33	-9(5)
27	2.3(5) Q	-0.40	-2.12	-8(20)
10	2.31(7)	-2.67 Q	-2.01	-8(3)
61	2.31(7)	-2.67 Q	-2.01	-8(3)
55	2.33(23)	-0.73	-1.80	-7(9)
60	2.34(8)	-1.97	-1.69	-6(4)
35	2.34(7)	-2.24	-1.69	-6(3)
50	2.39(8)	-1.35	-1.16	-4(4)
63	2.40(9)	-1.09	-1.05	-4(4)
59	2.40(14)	-0.70	-1.05	-4(6)
54	2.42(7)	-1.11	-0.84	-3(3)
64	2.43(18)	-0.38	-0.73	-3(7)
52	2.48(10)	-0.18	-0.20	-1(4)
53	2.48(9)	-0.20	-0.20	-1(4)
46	2.49(10)	-0.08	-0.09	0(4)
38	2.51(7)	0.17	0.12	0(3)
24	2.51(10)	0.12	0.12	0(4)
18	2.52(8)	0.27	0.23	1(4)
9	2.55(8)	0.64	0.55	2(4)
26	2.7(7) Q	0.26	1.94	1(3) × 10^{1}

Table A26 – Co-60 GH **assigned result 5.094(16) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
4	4.67(25)	-1.69	-2.27	-8(5)
48	4.77(5)	-6.16 Q	-1.74	-6.4(10)
5	4.8(5)	-0.61	-1.58	-6(9)
7	4.8(6)	-0.50	-1.41	-5(10)
17	4.88(18)	-1.18	-1.15	-4(4)
36	4.90(9)	-2.12	-1.04	-3.8(18)
14	4.92(24)	-0.72	-0.93	-3(5)
15	4.92(24)	-0.72	-0.93	-3(5)
49	4.98(25)	-0.45	-0.61	-2(5)
59	5.0(3)	-0.25	-0.39	-1(6)
10	5.03(15)	-0.42	-0.34	-1(3)
64	5.1(4)	-0.07	-0.13	0(7)
8	5.07(21)	-0.11	-0.13	0(4)
26	5.07(15)	-0.16	-0.13	0(3)
25	5.08(22)	-0.06	-0.07	0(5)
57	5.09(4)	-0.08	-0.02	-0.1(9)
46	5.10(21)	0.03	0.03	0(4)
13	5.10(17)	0.04	0.03	0(4)
50	5.11(15)	0.11	0.09	0(3)
55	5.11(21)	0.08	0.09	0(4)
54	5.12(16)	0.16	0.14	1(4)
21	5.17(10)	0.76	0.41	1.5(20)
18	5.18(15)	0.57	0.46	2(3)
9	5.19(13)	0.74	0.52	2(3)
38	5.22(14)	0.90	0.68	2(3)
52	5.23(21)	0.65	0.73	3(4)
53	5.23(16)	0.85	0.73	3(4)
28	5.24(25)	0.58	0.79	3(5)
24	5.25(18)	0.87	0.84	3(4)
60	5.26(15)	1.10	0.89	3(3)
35	5.27(15)	1.17	0.95	3(3)
61	5.30(18)	1.14	1.11	4(4)
47	5.4(5)	0.72	1.86	7(9)
63	5.47(20)	1.88	2.02	7(4)
27	5.5(12) Q	0.34	2.18	8(24)

Table A27 – Y-88 GH **assigned result 1.204(5) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
27	1.1(3) Q	-0.35	-2.10	-9(25)
5	1.14(11)	-0.58	-1.29	-5(9)
48	1.150(10)	-4.87 Q	-1.09	-4.5(9)
57	1.150(20)	-2.64 Q	-1.09	-4.5(17)
14	1.16(6)	-0.74	-0.89	-4(5)
13	1.18(5)	-0.49	-0.49	-2(4)
7	1.18(13)	-0.19	-0.49	-2(11)
59	1.18(7)	-0.35	-0.49	-2(6)
26	1.180(20)	-1.18	-0.49	-2.0(17)
50	1.19(4)	-0.36	-0.29	-1(4)
36	1.19(3)	-0.47	-0.29	-1.2(25)
55	1.20(6)	-0.07	-0.09	0(5)
38	1.20(15)	-0.03	-0.09	0(12)
10	1.20(4)	-0.11	-0.09	0(4)
54	1.21(4)	0.14	0.11	0(4)
18	1.21(4)	0.14	0.11	0(4)
35	1.21(4)	0.14	0.11	0(4)
28	1.21(9)	0.06	0.11	0(8)
46	1.21(5)	0.11	0.11	0(4)
52	1.21(5)	0.11	0.11	0(4)
53	1.21(5)	0.11	0.11	0(4)
60	1.22(4)	0.39	0.31	1(4)
15	1.22(6)	0.26	0.31	1(5)
64	1.22(9)	0.17	0.31	1(8)
49	1.23(7)	0.36	0.51	2(6)
8	1.24(7)	0.51	0.72	3(6)
17	1.24(5)	0.71	0.72	3(4)
21	1.24(3)	1.17	0.72	3.0(25)
63	1.26(5)	1.11	1.12	5(4)
24	1.26(5)	1.11	1.12	5(4)
9	1.28(5)	1.50	1.52	6(4)
47	1.28(10)	0.76	1.52	6(8)
25	1.32(8)	1.44	2.32	10(7)
61	1.34(6)	2.25	2.72 Q	11(5)

Table A28 – Zr-95 GH **assigned result 1.176(12) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	z-score	Deviation (%)
48	0.66(1)	-33.01 D	-9.21 D	-43.9(10)
7	0.82(10)	-3.53 D	-6.35 D	-30(9)
27	1.0(3)	-0.58	-3.14 Q	-15(3)
4	1.0(3) Q	-0.50	-2.42	-12(23)
5	1.13(11)	-0.41	-0.81	-4(9)
53	1.14(5)	-0.69	-0.64	-3(5)
36	1.14(7)	-0.50	-0.64	-3(6)
59	1.15(7)	-0.36	-0.46	-2(6)
49	1.15(7)	-0.36	-0.46	-2(6)
15	1.16(6)	-0.26	-0.28	-1(5)
46	1.17(5)	-0.11	-0.10	0(5)
55	1.18(7)	0.06	0.08	0(6)
26	1.18(1)	0.28	0.08	0.4(13)
14	1.19(4)	0.34	0.26	1(4)
8	1.20(6)	0.40	0.44	2(5)
18	1.20(4)	0.58	0.44	2(4)
25	1.20(9)	0.27	0.44	2(8)
17	1.21(5)	0.67	0.61	3(5)
10	1.21(5)	0.67	0.61	3(5)
54	1.22(4)	1.06	0.79	4(4)
50	1.22(4)	1.06	0.79	4(4)
60	1.22(6)	0.73	0.79	4(5)
47	1.22(9)	0.49	0.79	4(8)
52	1.22(5)	0.86	0.79	4(5)
38	1.23(4)	1.30	0.97	5(4)
64	1.23(11)	0.49	0.97	5(9)
21	1.23(3)	1.68	0.97	5(3)
63	1.24(5)	1.25	1.15	5(5)
35	1.25(4)	1.78	1.33	6(4)
9	1.25(9)	0.82	1.33	6(8)
28	1.25(8)	0.92	1.33	6(7)
13	1.25(5)	1.45	1.33	6(5)
24	1.26(6)	1.38	1.51	7(5)
61	1.55(9)	4.12 D	6.69 D	32(8)
57	1.690(20)	22.05 D	9.19 D	43.8(22)

Table A29 – Nb-95 GH **assigned result 2.456(25) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
38	1.22(6)	-19.01 D	-10.09 D	-50.3(25)
10	1.32(14)	-7.99 D	-9.27 D	-46(6)
59	1.80(10)	-6.36 D	-5.36 D	-27(4)
7	1.89(21)	-2.68 D	-4.62 D	-23(9)
27	2.2(8) Q	-0.32	-2.09	-1(4) × 10^{1}
26	2.23(11)	-2.00	-1.84	-9(5)
28	2.37(12)	-0.70	-0.70	-3(5)
48	2.37(12)	-2.20	-0.70	-3.5(16)
50	2.41(13)	-0.35	-0.37	-2(6)
60	2.4(6) Q	-0.03	-0.13	-1(25)
21	2.46(6)	0.06	0.03	0(3)
13	2.47(15)	0.09	0.12	1(6)
55	2.48(12)	0.20	0.20	1(5)
18	2.51(7)	0.73	0.44	2(3)
47	2.51(18)	0.30	0.44	2(8)
9	2.56(8)	1.24	0.85	4(4)
25	2.58(12)	1.01	1.01	5(5)
35	2.63(7)	2.34	1.42	7(3)
8	2.9(3)	1.74	3.71 Q	18(11)
53	3.55(12)	8.93 D	8.93 D	45(5)
5	3.6(4)	3.20 D	9.42 D	47(15)
52	3.65(15)	7.85 D	9.75 D	49(6)
4	3.7(3)	4.84 D	10.32 D	51(11)
63	4.01(9)	16.64 D	12.69 D	63(4)
36	4.33(9)	20.06 D	15.30 D	76(4)
49	4.46(24)	8.31 D	16.36 D	82(10)
54	4.75(14)	16.13 D	18.73 D	93(6)
15	4.76(24)	9.55 D	18.81 D	94(10)
64	4.9(4)	6.17 D	20.20 D	101(16)
61	5.07(17)	15.21 D	21.34 D	106(7)

Table A30 – Sb-125 GH **assigned result 5.39(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
4	4.60(25)	-3.11 D	-3.55 D	-15(5)
7	4.6(5)	-1.45	-3.41 Q	-14(10)
13	4.70(24)	-2.83 D	-3.10 D	-13(5)
57	4.87(4)	-9.15 Q	-2.33	-9.6(10)
48	4.91(6)	-6.63 Q	-2.15	-8.9(13)
5	5.1(5)	-0.60	-1.39	-6(10)
15	5.1(3)	-1.09	-1.30	-5(5)
52	5.16(21)	-1.07	-1.03	-4(4)
53	5.17(19)	-1.12	-0.98	-4(4)
25	5.17(25)	-0.86	-0.98	-4(5)
59	5.2(3)	-0.55	-0.76	-3(6)
35	5.23(15)	-1.02	-0.71	-3(3)
38	5.26(15)	-0.82	-0.58	-2(3)
14	5.27(25)	-0.47	-0.53	-2(5)
10	5.27(25)	-0.67	-0.53	-2(4)
17	5.29(21)	-0.46	-0.44	-2(4)
9	5.30(15)	-0.57	-0.40	-2(3)
55	5.3(3)	-0.27	-0.35	-1(6)
50	5.34(22)	-0.21	-0.22	-1(4)
26	5.35(11)	-0.32	-0.17	-0.7(22)
46	5.35(22)	-0.17	-0.17	-1(4)
28	5.35(25)	-0.15	-0.17	-1(5)
47	5.4(4)	-0.08	-0.13	-1(7)
60	5.40(20)	0.06	0.05	0(4)
8	5.5(3)	0.20	0.28	1(6)
18	5.45(15)	0.40	0.28	1(3)
64	5.5(4)	0.22	0.37	2(7)
36	5.50(14)	0.77	0.51	2(3)
21	5.51(11)	1.04	0.55	2.3(22)
49	5.5(3)	0.49	0.64	3(6)
54	5.5(3)	0.52	0.69	3(6)
63	5.62(21)	1.09	1.05	4(4)
61	5.68(23)	1.25	1.32	5(5)
24	5.70(25)	1.23	1.41	6(5)
27	6.3(13)	0.70	4.11 Q	17(24)

Table A31 – Ba-133 GH **assigned result 4.79(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
7	3.4(4)	-3.66 D	-6.27 D	-29(8)
48	3.80(5)	-15.45 D	-4.43 D	-20.7(12)
13	3.82(20)	-4.75 D	-4.34 D	-20(5)
4	3.9(3)	-3.26 D	-3.99 D	-19(6)
54	4.08(19)	-3.65 D	-3.18 D	-15(4)
35	4.15(13)	-4.70 D	-2.87 D	-13(3)
25	4.29(20)	-2.45	-2.24	-10(5)
5	4.3(5)	-1.11	-2.15	-10(9)
28	4.35(21)	-2.06	-1.97	-9(5)
17	4.39(16)	-2.42	-1.79	-8(4)
53	4.41(16)	-2.30	-1.70	-8(4)
10	4.46(14)	-2.26	-1.48	-7(3)
57	4.51(3)	-5.59 Q	-1.25	-5.8(10)
8	4.58(25)	-0.83	-0.94	-4(6)
55	4.63(25)	-0.63	-0.72	-3(6)
59	4.7(3)	-0.51	-0.63	-3(6)
60	4.66(23)	-0.56	-0.58	-3(5)
36	4.67(19)	-0.62	-0.54	-2(4)
14	4.67(22)	-0.53	-0.54	-2(5)
47	4.7(3)	-0.35	-0.49	-2(7)
38	4.7(3)	-0.32	-0.45	-2(7)
50	4.71(18)	-0.43	-0.36	-2(4)
21	4.73(9)	-0.61	-0.27	-1.2(21)
52	4.75(19)	-0.20	-0.18	-1(4)
46	4.76(19)	-0.15	-0.13	-1(4)
49	4.8(3)	0.19	0.23	1(6)
9	4.87(13)	0.59	0.36	2(3)
63	4.88(18)	0.49	0.41	2(4)
18	4.90(14)	0.76	0.49	2(3)
61	4.90(15)	0.71	0.49	2(4)
64	5.0(4)	0.40	0.76	4(9)
24	5.0(3)	0.73	0.99	5(7)
26	5.55(21)	3.56 D	3.41 D	16(5)
27	6.3(13)	1.16	6.77 Q	$3(3) \times 10^1$

Table A32 – Cs-134 GH **assigned result 2.736(19) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
61	2.03(8)	-8.58 D	-6.35 D	-26(3)
7	2.25(25)	-1.94	-4.37 Q	-18(9)
4	2.30(25)	-1.74	-3.92 Q	-16(9)
17	2.31(9)	-4.63 D	-3.83 D	-16(4)
25	2.35(11)	-3.45 D	-3.47 D	-14(4)
48	2.36(3)	-10.58 D	-3.38 D	-13.7(12)
5	2.40(24)	-1.39	-3.02 Q	-12(9)
28	2.45(18)	-1.58	-2.57	-10(7)
57	2.510(20)	-8.18 Q	-2.03	-8.2(10)
63	2.54(9)	-2.13	-1.76	-7(4)
49	2.55(13)	-1.41	-1.67	-7(5)
10	2.55(8)	-2.26	-1.67	-7(3)
35	2.57(7)	-2.28	-1.49	-6(3)
14	2.59(12)	-1.20	-1.31	-5(5)
50	2.60(8)	-1.65	-1.22	-5(3)
59	2.60(15)	-0.90	-1.22	-5(6)
46	2.68(11)	-0.50	-0.50	-2(4)
15	2.68(13)	-0.42	-0.50	-2(5)
9	2.69(7)	-0.63	-0.41	-2(3)
36	2.70(5)	-0.66	-0.32	-1.3(20)
8	2.70(14)	-0.25	-0.32	-1(5)
60	2.71(11)	-0.23	-0.23	-1(4)
21	2.73(5)	-0.10	-0.05	-0.2(20)
18	2.74(8)	0.05	0.04	0(3)
55	2.74(13)	0.03	0.04	0(5)
53	2.74(8)	0.05	0.04	0(3)
38	2.77(7)	0.48	0.31	1(3)
27	2.8(6) Q	0.11	0.58	2(22)
64	2.81(19)	0.39	0.67	3(7)
54	2.83(10)	0.93	0.85	3(4)
47	2.83(19)	0.49	0.85	3(7)
24	2.86(11)	1.11	1.12	5(4)
52	2.86(12)	1.02	1.12	5(5)
13	2.92(12)	1.52	1.66	7(5)
26	3.41(9)	7.33 D	6.07 D	25(4)

Table A33 – Cs-137 GH **assigned result 2.632(18) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
61	2.30(7)	-4.60 D	-3.33 D	-13(3)
5	2.38(24)	-1.05	-2.53	-10(9)
4	2.4(3)	-0.89	-2.33	-9(10)
7	2.4(3)	-0.78	-2.13	-8(10)
15	2.55(13)	-0.63	-0.82	-3(5)
53	2.59(10)	-0.42	-0.42	-2(4)
59	2.59(15)	-0.28	-0.42	-2(6)
36	2.61(5)	-0.42	-0.22	-0.8(20)
26	2.610(20)	-0.83	-0.22	-0.8(10)
55	2.62(12)	-0.10	-0.12	0(5)
46	2.62(11)	-0.11	-0.12	0(5)
25	2.63(12)	-0.02	-0.02	0(5)
8	2.64(12)	0.06	0.08	0(5)
13	2.64(10)	0.08	0.08	0(4)
38	2.66(8)	0.34	0.28	1(3)
14	2.67(9)	0.41	0.38	1(4)
17	2.68(10)	0.47	0.48	2(4)
48	2.68(3)	1.36	0.48	1.8(13)
9	2.69(8)	0.70	0.58	2(3)
50	2.70(9)	0.74	0.68	3(4)
60	2.70(9)	0.83	0.68	3(3)
57	2.71(3)	2.22	0.78	3.0(13)
18	2.71(8)	0.95	0.78	3(3)
10	2.71(8)	0.95	0.78	3(3)
47	2.71(18)	0.43	0.78	3(7)
49	2.73(14)	0.69	0.98	4(6)
28	2.75(14)	0.83	1.18	4(6)
21	2.75(6)	1.88	1.18	4.5(24)
54	2.76(10)	1.26	1.28	5(4)
52	2.76(12)	1.05	1.28	5(5)
64	2.79(22)	0.71	1.58	6(8)
35	2.81(8)	2.17	1.78	7(3)
63	2.81(6)	2.84 Q	1.78	6.8(24)
24	2.86(16)	1.41	2.28	9(6)
27	3.2(7)	0.81	5.69 Q	$2(3) \times 10^1$

Table A34 – Eu-152 GH **assigned result 2.380(16) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
25	1.82(10)	-5.53 D	-5.39 D	-24(5)
4	2.00(25)	-1.52	-3.66 Q	-16(11)
48	2.09(3)	-8.54 D	-2.79 D	-12.2(14)
61	2.10(8)	-3.43 D	-2.69 D	-12(4)
7	2.2(3)	-0.78	-2.02	-9(11)
26	2.17(17)	-1.23	-2.02	-9(7)
14	2.20(11)	-1.62	-1.73	-8(5)
17	2.20(9)	-1.97	-1.73	-8(4)
10	2.21(7)	-2.37	-1.64	-7(3)
13	2.22(11)	-1.44	-1.54	-7(5)
53	2.23(10)	-1.48	-1.44	-6(5)
35	2.23(6)	-2.42	-1.44	-6(3)
49	2.26(12)	-0.99	-1.16	-5(5)
57	2.290(20)	-3.52 Q	-0.87	-3.8(11)
36	2.32(11)	-0.54	-0.58	-3(5)
59	2.33(13)	-0.38	-0.48	-2(6)
52	2.35(10)	-0.30	-0.29	-1(5)
47	2.36(16)	-0.13	-0.19	-1(7)
21	2.36(5)	-0.39	-0.19	-0.9(22)
18	2.37(6)	-0.16	-0.10	0(3)
50	2.38(8)	0.00	0.00	0(4)
38	2.39(7)	0.14	0.09	0(3)
27	2.4(5) Q	0.04	0.19	1(21)
15	2.40(10)	0.20	0.19	1(5)
60	2.42(9)	0.43	0.38	2(4)
8	2.42(11)	0.36	0.38	2(5)
63	2.44(9)	0.65	0.57	3(4)
9	2.45(10)	0.69	0.67	3(5)
46	2.45(11)	0.63	0.67	3(5)
55	2.45(12)	0.58	0.67	3(5)
24	2.45(7)	0.97	0.67	3(3)
64	2.47(17)	0.53	0.86	4(7)

Table A35 – H-3 LB **assigned result 491(5) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
49	432(5)	-8.79 D	-2.59 D	-12.2(13)
41	434(13)	-4.10 Q	-2.49	-12(3)
40	448(14)	-2.89 Q	-1.88	-9(3)
21	461(25)	-1.19	-1.32	-6(5)
32d	466(18)	-1.36	-1.10	-5(4)
19	470(22)	-0.95	-0.93	-4(5)
56	471(9)	-2.02	-0.89	-4.2(20)
32c	47(6) × 10^{1}	-0.30	-0.80	-4(13)
5c	47(7) × 10^{1}	-0.24	-0.76	-4(15)
4	48(3) × 10^{1}	-0.29	-0.37	-2(6)
36	484(22)	-0.33	-0.32	-2(5)
5d	49(5) × 10^{1}	-0.13	-0.28	-1(10)
29	490(10)	-0.13	-0.06	-0.3(23)
22	492(25)	0.02	0.02	0(5)
62	496(17)	0.26	0.20	1(4)
17	50(11) × 10^{1} Q	0.05	0.24	1(22)
38d	497(15)	0.35	0.24	1(4)
55	498(18)	0.35	0.28	1(4)
9	504(24)	0.51	0.54	3(5)
8	51(6) × 10^{1}	0.24	0.64	3(13)
35d	52(4) × 10^{1}	0.58	1.02	5(8)
35c	52(6) × 10^{1}	0.47	0.00	6(12)
25	521(23)	1.26	1.28	6(5)
38c	525(15)	2.12	1.45	7(4)
13	54(5) × 10^{1}	1.02	2.03	10(9)
34	55(4) × 10^{1}	1.57	2.33	11(7)
60	55(4) × 10^{1}	1.75	2.54	12(7)
28	565(23)	3.12 D	3.19 D	15(5)

Table A36 – C-14 LB **assigned result 160.4(10) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
48	10(5) × 10^{1}	-1.28	-4.79 Q	-4(3) × 10^{1}
32	130(20)	-1.52	-2.41	-19(12)
5	139(21)	-1.03	-1.70	-13(13)
25	143(9)	-1.99	-1.38	-11(6)
49	157(3)	-0.98	-0.24	-1.9(19)
38	161(11)	0.05	0.05	0(7)
35	170(17)	0.56	0.76	6(11)
55	21(4) × 10^{1}	1.25	3.81 Q	30(24)
34	238(19)	4.15 D	6.17 D	48(12)
9	301(11)	12.95 D	11.17 D	88(7)
8	380(14)	16.24 D	17.45 D	137(9)

Table A37 – S-35 LB **assigned result 411.1(10) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
34	237(16)	-10.68 D	-6.34 D	-42(4)
35	285(15)	-8.39 D	-4.59 D	-31(4)
48	30(3) × 10^{1}	-4.11 D	-4.04 D	-27(7)
9	340(6)	-11.82 D	-2.59 D	-17.3(15)
60	385(25)	-1.04	-0.95	-6(6)
25	402(20)	-0.46	-0.33	-2(5)
8	41(6) × 10^{1}	-0.01	-0.02	0(15)
55	42(4) × 10^{1}	0.23	0.32	2(9)
46	420(23)	0.39	0.32	2(6)
28	46(9) × 10^{1}	0.49	1.67	11(23)

Appendix B. Results sorted by laboratory

Table B1 – Laboratory 4

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{238}U	1.25(9)	1.24(3)	0.09	0.10	1(8)
^{238}Pu	15.2(5)	15.28(5)	-0.17	-0.10	-1(3)
^{239}Pu	13.3(6)	13.29(6)	0.02	0.02	0(4)
^{241}Am	12.9(7)	11.99(4)	1.41	1.52	8(6)
^{60}Co	17.00(17)	18.84(6)	-10.19 Q	-2.18	-9.8(10)
^{133}Ba	4.00(21)	5.74(4)	-8.15 D	-4.64 D	-30(4)
^{134}Cs	5.00(20)	5.30(4)	-1.49	-0.99	-6(4)
^{3}H	48(3) × 10^{1}	491(5)	-0.29	-0.37	-2(6)
	(Bq g^{-1})	(Bq g^{-1})			
^{238}U *a*	1.10(10)	1.059(24)	0.40	0.87	4(10)
^{238}U *g*	1.10(19)	1.059(24)	0.22	0.87	4(18)
^{238}Pu	2.80(9)	2.607(9)	2.28	1.40	7(4)
^{239}Pu	6.10(24)	6.06(3)	0.16	0.12	1(4)
^{241}Am *a*	4.10(12)	3.691(13)	3.31 Q	2.20	11(4)
^{241}Am *g*	4.0 (7)	3.691(13)	0.48	1.66	8(17)
^{22}Na	2.2(3)	2.498(9)	-1.15	-3.18 Q	-12(10)
^{60}Co	4.67(25)	5.094(16)	-1.69	-2.27	-8(5)
^{95}Zr	1.0(3) Q	1.176(12)	-0.50	-2.42	-12(23)
^{95}Nb	3.7(3)	2.456(25)	4.84 D	10.32 D	51(11)
^{125}Sb	4.60(25)	5.39(4)	-3.11 D	-3.55 D	-15(5)
^{133}Ba	3.9(3)	4.79(4)	-3.26 D	-3.99 D	-19(6)
^{134}Cs	2.30(25)	2.736(19)	-1.74	-3.92 Q	-16(9)
^{137}Cs	2.4(3)	2.632(18)	-0.89	-2.33	-9(10)
^{152}Eu	2.00(25)	2.380(16)	-1.52	-3.66 Q	-16(11)

Table B2 – Laboratory 5

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.4(4)	3.718(14)	-0.99	-1.04	-9(9)
^{60}Co	19.4(19)	18.84(6)	0.30	0.69	3(10)
^{88}Y	3.6(4)	3.843(14)	-0.79	-0.99	-7(9)
^{95}Zr	3.9(4)	1.836(19)	5.26 D	8.05 D	112(21)
^{95}Nb	6.9(7)	3.84(4)	4.43 D	6.31 D	80(18)
^{125}Sb	6.8(7)	6.48(4)	0.44	0.62	5(11)
^{133}Ba	7.2(7)	5.74(4)	2.05	3.93 Q	26(13)
^{134}Cs	5.5(6)	5.30(4)	0.32	0.58	3(10)
^{137}Cs	4.1(4)	2.884(20)	2.94 D	5.94 D	42(14)
^{3}H *d*	49(5) × 10^1	491(5)	-0.13	-0.28	-1(10)
^{3}H *c*	47(7) × 10^1	491(5)	-0.24	-0.76	-4(15)
^{14}C	139(21)	160.4(10)	-1.03	-1.70	-13(13)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.26(23)	2.498(9)	-1.04	-2.54	-10(9)
^{60}Co	4.8(5)	5.094(16)	-0.61	-1.58	-6(9)
^{88}Y	1.14(11)	1.204(5)	-0.58	-1.29	-5(9)
^{95}Zr	1.13(11)	1.176(12)	-0.41	-0.81	-4(9)
^{95}Nb	3.6(4)	2.456(25)	3.20 D	9.42 D	47(15)
^{125}Sb	5.1(5)	5.39(4)	-0.60	-1.39	-6(10)
^{133}Ba	4.3(5)	4.79(4)	-1.11	-2.15	-10(9)
^{134}Cs	2.40(24)	2.736(19)	-1.39	-3.02 Q	-12(9)
^{137}Cs	2.38(24)	2.632(18)	-1.05	-2.53	-10(9)

Table B3 − Laboratory 7

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{55}Fe	18(6) Q	15.8(3)	0.34	1.46	1(4) × 10^{1}
^{90}Sr	17.5(11)	8.900(19)	7.61 D	12.00 D	97(13)
^{60}Co	20(3)	18.84(6)	0.51	1.86	8(16)
^{95}Nb	4.0(11)	3.84(4)	0.16	0.34	0(3) × 10^{1}
^{133}Ba	7.5(19)	5.74(4)	0.93	4.68 Q	3(4) × 10^{1}
^{134}Cs	5.8(14)	5.30(4)	0.36	1.58	1(3) × 10^{1}
^{137}Cs	2.6(12)	2.884(20)	-0.22	-1.35	-1(5) × 10^{1}
^{154}Eu	18(9)	0.0127(20)	–	–	–
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	5.1(9)	6.89(12)	-1.95	-3.42 Q	-26(13)
^{90}Sr	17.9(9)	10.189(16)	8.68 D	10.52 D	75(9)
^{60}Co	4.8(6)	5.094(16)	-0.50	-1.41	-5(10)
^{88}Y	1.18(13)	1.204(5)	-0.19	-0.49	-2(11)
^{95}Zr	0.82(10)	1.176(12)	-3.53 D	-6.35 D	-30(9)
^{95}Nb	1.89(21)	2.456(25)	-2.68 D	-4.62 D	-23(9)
^{125}Sb	4.6(5)	5.39(4)	-1.45	-3.41 Q	-14(10)
^{133}Ba	3.4(4)	4.79(4)	-3.66 D	-6.27 D	-29(8)
^{134}Cs	2.25(25)	2.736(19)	-1.94	-4.37 Q	-18(9)
^{137}Cs	2.4(3)	2.632(18)	-0.78	-2.13	-8(10)
^{152}Eu	2.2(3)	2.380(16)	-0.78	-2.02	-9(11)
^{154}Eu	6.3(7)	0.0072(11)	–	–	–

Table B4 — Laboratory 8

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{90}Sr	8.5(3)	8.900(19)	-1.60	-0.61	-5(3)
^{238}U *a*	1.21(5)	1.24(3)	-0.62	-0.39	-3(4)
^{238}U *m*	1.340(20)	1.24(3)	2.73 Q	1.19	8(3)
^{238}Pu	15.5(13)	15.28(5)	0.17	0.29	1(8)
^{239}Pu	13.3(11)	13.29(6)	0.01	0.02	0(8)
^{22}Na	3.54(23)	3.718(14)	-0.77	-0.55	-5(6)
^{60}Co	18.8(8)	18.84(6)	-0.05	-0.04	0(5)
^{88}Y	4.8(3)	3.843(14)	2.92 D	3.19 D	24(8)
^{95}Zr	1.9(3)	1.836(19)	0.25	0.29	4(16)
^{95}Nb	5.9(14)	3.84(4)	1.49	4.21 Q	5(4) × 10^{1}
^{125}Sb	7.3(5)	6.48(4)	1.61	1.62	12(8)
^{133}Ba	5.9(3)	5.74(4)	0.42	0.34	2(6)
^{134}Cs	5.6(3)	5.30(4)	1.08	1.06	6(6)
^{137}Cs	3.05(19)	2.884(20)	0.87	0.82	6(7)
^{152}Eu	4.6(7)	4.19(3)	0.59	1.10	9(15)
^{3}H	51(6) × 10^{1}	491(5)	0.24	0.64	3(13)
^{14}C	380(14)	160.4(10)	16.24 D	17.45 D	137(9)
^{35}S	41(6) × 10^{1}	411.1(11)	-0.01	-0.02	0(15)
	(Bq g^{-1})	(Bq g^{-1})			
^{90}Sr	12.0(13)	10.189(16)	1.35	2.49	18(13)
^{238}U *a*	1.07(3)	1.059(24)	0.28	0.23	1(4)
^{238}U *m*	1.26(3)	1.059(24)	5.58 D	4.24 D	19(4)
^{238}Pu	3.0(3)	2.607(9)	1.39	2.70 Q	14(10)
^{239}Pu	6.9(6)	6.06(3)	1.42	2.51	14(10)
^{241}Am *a*	4.3(4)	3.691(13)	1.73	3.27 Q	17(10)
^{241}Am x_1	3.73(16)	3.691(13)	0.24	0.21	1(5)
^{241}Am x_2	3.62(16)	3.691(13)	-0.46	-0.38	-2(5)
^{241}Am *g*	3.71(15)	3.691(13)	0.13	0.10	1(4)
^{22}Na	2.22(9)	2.498(9)	-3.08 D	-2.97 D	-11(4)
^{60}Co	5.07(21)	5.094(16)	-0.11	-0.13	0(4)
^{88}Y	1.24(7)	1.204(5)	0.51	0.72	3(6)
^{95}Zr	1.20(6)	1.176(12)	0.40	0.44	2(5)

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{95}Nb	2.9(3)	2.456(25)	1.74	3.71 Q	18(11)
^{125}Sb	5.5(3)	5.39(4)	0.20	0.28	1(6)
^{133}Ba	4.58(25)	4.79(4)	-0.83	-0.94	-4(6)
^{134}Cs	2.70(14)	2.736(19)	-0.25	-0.32	-1(5)
^{137}Cs	2.64(12)	2.632(18)	0.06	0.08	0(5)
^{152}Eu	2.42(11)	2.380(16)	0.36	0.38	2(5)

Table B5 − Laboratory 9

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{3}H	504(24)	491(5)	0.51	0.54	3(5)
^{14}C	301(11)	160.4(10)	12.95 D	11.17 D	88(7)
^{35}S	340(6)	411.1(11)	-11.82 D	-2.59 D	-17.3(15)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.55(8)	2.498(9)	0.64	0.55	2(4)
^{60}Co	5.19(13)	5.094(16)	0.74	0.52	2(3)
^{88}Y	1.28(5)	1.204(5)	1.50	1.52	6(4)
^{95}Zr	1.25(9)	1.176(12)	0.82	1.33	6(8)
^{95}Nb	2.56(8)	2.456(25)	1.24	0.85	4(4)
^{125}Sb	5.30(15)	5.39(4)	-0.57	-0.40	-2(3)
^{133}Ba	4.87(13)	4.79(4)	0.59	0.36	2(3)
^{134}Cs	2.69(7)	2.736(19)	-0.63	-0.41	-2(3)
^{137}Cs	2.69(8)	2.632(18)	0.70	0.58	2(3)
^{152}Eu	2.45(10)	2.380(16)	0.69	0.67	3(5)

Table B6 – Laboratory 10

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.3(6)	3.718(14)	-0.76	-1.32	-12(15)
^{60}Co	17.2(8)	18.84(6)	-2.08	-1.91	-9(4)
^{88}Y	3.5(7)	3.843(14)	-0.50	-1.21	-9(18)
^{95}Zr	2.6(11)	1.836(19)	0.63	2.80 Q	4(6) × 10^{1}
^{95}Nb	0.0(13)	3.84(4)	-2.86 D	-7.90 D	-100
^{125}Sb	6.2(9)	6.48(4)	-0.36	-0.64	-5(13)
^{133}Ba	5.2(6)	5.74(4)	-0.87	-1.39	-9(10)
^{134}Cs	4.6(3)	5.30(4)	-2.54	-2.42	-14(6)
^{137}Cs	3.0(3)	2.884(20)	0.27	0.37	3(10)
^{152}Eu	3.2(5)	4.19(3)	-2.11	-2.78 Q	-23(11)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.31(7)	2.498(9)	-2.67 Q	-2.01	-8(3)
^{60}Co	5.03(15)	5.094(16)	-0.42	-0.34	-1(3)
^{88}Y	1.20(4)	1.204(5)	-0.11	-0.09	0(4)
^{95}Zr	1.21(5)	1.176(12)	0.67	0.61	3(5)
^{95}Nb	1.32(14)	2.456(25)	-7.99 D	-9.27 D	-46(6)
^{125}Sb	5.27(17)	5.39(4)	-0.67	-0.53	-2(4)
^{133}Ba	4.46(14)	4.79(4)	-2.26	-1.48	-7(3)
^{134}Cs	2.55(8)	2.736(19)	-2.26	-1.67	-7(3)
^{137}Cs	2.71(8)	2.632(18)	0.95	0.78	3(3)
^{152}Eu	2.21(7)	2.380(16)	-2.37	-1.64	-7(3)

Table B7 – Laboratory 13

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{90}Sr	14.2(6)	8.900(19)	8.83 D	7.40 D	60(7)
^{238}U	1.15(8)	1.24(3)	-1.08	-1.12	-7(7)
^{238}Pu	15.4(7)	15.28(5)	0.17	0.16	1(5)
^{239}Pu	13.3(6)	13.29(6)	0.02	0.02	0(5)
^{241}Am	12.1(6)	11.99(4)	0.19	0.19	1(5)
^{22}Na	3.34(18)	3.718(14)	-2.09	-1.16	-10(5)
^{60}Co	18.7(7)	18.84(6)	-0.25	-0.20	-1(4)
^{88}Y	3.8(3)	3.843(14)	-0.20	-0.19	-1(7)
^{95}Zr	2.5(4)	1.836(19)	1.68	2.64 Q	37(22)
^{95}Nb	2.7(8)	3.84(4)	-1.49	-2.34	-30(20)
^{125}Sb	3.8(4)	6.48(4)	-7.64 D	-5.54 D	-42(6)
^{133}Ba	5.0(3)	5.74(4)	-2.57	-2.00	-13(5)
^{134}Cs	5.4(3)	5.30(4)	0.15	0.15	1(6)
^{137}Cs	2.96(17)	2.884(20)	0.44	0.37	3(6)
^{152}Eu	3.8(4)	4.19(3)	-1.20	-1.23	-10(8)
^{3}H	54(5) × 10^{1}	491(5)	1.02	2.03	10(9)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.13(7)	2.498(9)	-5.22 Q	-3.93	-15(3)
^{60}Co	5.10(17)	5.094(16)	0.04	0.03	0(4)
^{88}Y	1.18(5)	1.204(5)	-0.49	-0.49	-2(4)
^{95}Zr	1.25(5)	1.176(12)	1.45	1.33	6(5)
^{95}Nb	2.47(15)	2.456(25)	0.09	0.12	1(6)
^{125}Sb	4.70(24)	5.39(4)	-2.83 D	-3.10 D	-13(5)
^{133}Ba	3.82(20)	4.79(4)	-4.75 D	-4.34 D	-20(5)
^{134}Cs	2.92(12)	2.736(19)	1.52	1.66	7(5)
^{137}Cs	2.64(10)	2.632(18)	0.08	0.08	0(4)
^{152}Eu	2.22(11)	2.380(16)	-1.44	-1.54	-7(5)

Table B8 – Laboratory 14

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{90}Sr	11.6(5)	10.189(16)	3.00 Q	1.98	14(5)
^{238}Pu	3.5(3)	2.607(9)	3.23 D	6.32 D	33(10)
^{239}Pu	5.8(5)	6.06(3)	-0.51	-0.67	-4(7)
^{241}Am	2.68(21)	3.691(13)	-4.80 D	-5.42 D	-27(6)
^{22}Na	2.23(11)	2.498(9)	-2.43	-2.86 Q	-11(5)
^{60}Co	4.92(24)	5.094(16)	-0.72	-0.93	-3(5)
^{88}Y	1.16(6)	1.204(5)	-0.74	-0.89	-4(5)
^{95}Zr	1.19(4)	1.176(12)	0.34	0.26	1(4)
^{125}Sb	5.27(25)	5.39(4)	-0.47	-0.53	-2(5)
^{133}Ba	4.67(22)	4.79(4)	-0.53	-0.54	-2(5)
^{134}Cs	2.59(12)	2.736(19)	-1.20	-1.31	-5(5)
^{137}Cs	2.67(9)	2.632(18)	0.41	0.38	1(4)
^{152}Eu	2.20(11)	2.380(16)	-1.62	-1.73	-8(5)

Table B9 − Laboratory 15

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{60}Co	17.9(13)	18.84(6)	-0.71	-1.11	-5(7)
^{88}Y	4.0(13)	3.843(14)	0.09	0.41	0(4) × 10^{1}
^{95}Zr	1.9(20) Q	1.836(19)	0.04	0.29	0(11) × 10^{1}
^{95}Nb	7(3)	3.84(4)	1.05	5.78 Q	7(7) × 10^{1}
^{125}Sb	7.8(25)	6.48(4)	0.52	2.72 Q	2(4) × 10^{1}
^{134}Cs	4.8(9)	5.30(4)	-0.64	-1.77	-10(16)
^{137}Cs	2.2(8)	2.884(20)	-0.80	-3.23 Q	-2(3) × 10^{1}
^{152}Eu	5.8(16)	4.19(3)	1.06	4.80 Q	4(4) × 10^{1}
	(Bq g^{-1})	(Bq g^{-1})			
^{60}Co	4.92(24)	5.094(16)	-0.72	-0.93	-3(5)
^{88}Y	1.22(6)	1.204(5)	0.26	0.31	1(5)
^{95}Zr	1.16(6)	1.176(12)	-0.26	-0.28	-1(5)
^{95}Nb	4.76(24)	2.456(25)	9.55 D	18.81 D	94(10)
^{125}Sb	5.1(3)	5.39(4)	-1.09	-1.30	-5(5)
^{134}Cs	2.68(13)	2.736(19)	-0.42	-0.50	-2(5)
^{137}Cs	2.55(13)	2.632(18)	-0.63	-0.82	-3(5)
^{152}Eu	2.40(10)	2.380(16)	0.20	0.19	1(5)

Table B10 — Laboratory 17

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{238}U	1.19(8)	1.24(3)	-0.61	-0.63	-4(7)
^{238}Pu	16.9(10)	15.28(5)	1.57	2.08	10(7)
^{239}Pu	14.5(9)	13.29(6)	1.41	1.97	9(7)
^{241}Am	12.1(7)	11.99(4)	0.17	0.20	1(6)
^{22}Na	3.6(4)	3.718(14)	-0.30	-0.39	-3(11)
^{60}Co	17.2(8)	18.84(6)	-2.11	-1.93	-9(4)
^{88}Y	3.6(5)	3.843(14)	-0.48	-0.85	-6(13)
^{125}Sb	8.5(11)	6.48(4)	1.73	4.05 Q	30(18)
^{133}Ba	5.4(4)	5.74(4)	-1.03	-0.99	-6(7)
^{134}Cs	5.1(4)	5.30(4)	-0.70	-0.76	-4(6)
^{137}Cs	3.2(5)	2.884(20)	0.66	1.51	11(16)
^{152}Eu	3.2(5)	4.19(3)	-2.08	-2.98 Q	-24(12)
^{3}H	50(11) × 10^{1} Q	491(5)	0.05	0.24	1(22)
	(Bq g^{-1})	(Bq g^{-1})			
^{238}U	1.01(5)	1.059(24)	-0.88	-1.03	-5(5)
^{238}Pu	2.91(16)	2.607(9)	1.89	2.19	12(6)
^{239}Pu	6.8(4)	6.06(3)	1.99	2.24	12(6)
^{241}Am	3.76(19)	3.691(13)	0.36	0.37	2(5)
^{22}Na	2.17(8)	2.498(9)	-4.08 D	-3.50 D	-13(4)
^{60}Co	4.88(18)	5.094(16)	-1.18	-1.15	-4(4)
^{88}Y	1.24(5)	1.204(5)	0.71	0.72	3(4)
^{95}Zr	1.21(5)	1.176(12)	0.67	0.61	3(5)
^{125}Sb	5.29(21)	5.39(4)	-0.46	-0.44	-2(4)
^{133}Ba	4.39(16)	4.79(4)	-2.42	-1.79	-8(4)
^{134}Cs	2.31(9)	2.736(19)	-4.63 D	-3.83 D	-16(4)
^{137}Cs	2.68(10)	2.632(18)	0.47	0.48	2(4)
^{152}Eu	2.20(9)	2.380(16)	-1.97	-1.73	-8(4)

Table B11 — Laboratory 18

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	4.00(20)	3.718(14)	1.41	0.87	8(6)
^{60}Co	19.9(6)	18.84(6)	1.76	1.26	6(4)
^{88}Y	4.20(20)	3.843(14)	1.78	1.25	9(4)
^{95}Zr	1.94(12)	1.836(19)	0.86	0.41	6(7)
^{95}Nb	4.00(16)	3.84(4)	1.00	0.34	4(5)
^{125}Sb	7.02(23)	6.48(4)	2.31	1.11	8(4)
^{133}Ba	6.32(19)	5.74(4)	2.98 Q	1.54	10(4)
^{134}Cs	5.73(17)	5.30(4)	2.44	1.39	8(4)
^{137}Cs	3.18(10)	2.884(20)	2.90 Q	1.46	10(4)
^{152}Eu	4.50(20)	4.19(3)	1.52	0.90	7(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.52(8)	2.498(9)	0.27	0.23	1(4)
^{60}Co	5.18(15)	5.094(16)	0.57	0.46	2(3)
^{88}Y	1.21(4)	1.204(5)	0.14	0.11	0(4)
^{95}Zr	1.20(4)	1.176(12)	0.58	0.44	2(4)
^{95}Nb	2.51(7)	2.456(25)	0.73	0.44	2(3)
^{125}Sb	5.45(15)	5.39(4)	0.40	0.28	1(3)
^{133}Ba	4.90(14)	4.79(4)	0.76	0.49	2(3)
^{134}Cs	2.74(8)	2.736(19)	0.05	0.04	0(3)
^{137}Cs	2.71(8)	2.632(18)	0.95	0.78	3(3)
^{152}Eu	2.37(6)	2.380(16)	-0.16	-0.10	0(3)

Table B12 − Laboratory 19

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{238}Pu	12.0(5)	15.28(5)	-6.52 D	-4.33 D	-21(4)
^{239}Pu	8.6(3)	13.29(6)	-15.33 D	-7.70 D	-35.3(23)
^{22}Na	3.30(15)	3.718(14)	-2.77 Q	-1.29	-11(4)
^{60}Co	18.6(6)	18.84(6)	-0.39	-0.28	-1(4)
^{88}Y	3.80(20)	3.843(14)	-0.22	-0.15	-1(5)
^{95}Zr	1.70(20)	1.836(19)	-0.68	-0.53	-7(11)
^{95}Nb	6.9(3)	3.84(4)	10.13 D	6.31 D	80(8)
^{125}Sb	6.4(3)	6.48(4)	-0.27	-0.17	-1(5)
^{133}Ba	5.50(20)	5.74(4)	-1.19	-0.64	-4(4)
^{134}Cs	4.80(15)	5.30(4)	-3.24 Q	-1.64	-9(3)
^{137}Cs	2.90(10)	2.884(20)	0.15	0.08	1(4)
^{152}Eu	3.60(20)	4.19(3)	-2.93 Q	-1.73	-14(5)
^{3}H	470(22)	491(5)	-0.95	-0.93	-4(5)

Table B13 – Laboratory 21

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{55}Fe	17.9(11)	15.8(3)	1.82	1.52	13(7)
^{89}Sr	17.1(19)	17.8(3)	-0.39	-0.35	-4(11)
^{90}Sr	9.3(8)	8.900(19)	0.55	0.61	5(9)
^{241}Am	12.4(4)	11.99(4)	1.03	0.69	3(4)
^{22}Na	3.15(13)	3.718(14)	-4.34 Q	-1.75	-15(4)
^{60}Co	19.0(5)	18.84(6)	0.32	0.19	1(3)
^{88}Y	4.10(10)	3.843(14)	2.54	0.90	7(3)
^{95}Zr	1.90(20)	1.836(19)	0.32	0.25	3(11)
^{95}Nb	4.00(19)	3.84(4)	0.85	0.34	4(5)
^{125}Sb	6.70(20)	6.48(4)	1.08	0.45	3(4)
^{133}Ba	5.90(20)	5.74(4)	0.77	0.42	3(4)
^{134}Cs	5.50(10)	5.30(4)	1.83	0.64	3.7(20)
^{137}Cs	2.95(16)	2.884(20)	0.41	0.32	2(6)
^{152}Eu	4.30(20)	4.19(3)	0.53	0.31	3(5)
^{3}H	461(25)	491(5)	-1.19	-1.32	-6(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	8.0(5)	6.89(12)	2.16	2.10	16(8)
^{238}U	1.03(4)	1.059(24)	-0.62	-0.61	-3(5)
^{238}Pu	14(3)	2.607(9)	4.38 D	82.49 D	44(10) × 10^{1}
^{241}Am	3.76(9)	3.691(13)	0.76	0.37	1.9(25)
^{22}Na	2.03(5)	2.498(9)	-9.22 D	-5.00 D	-18.7(20)
^{60}Co	5.17(10)	5.094(16)	0.76	0.41	1.5(20)
^{88}Y	1.24(3)	1.204(5)	1.17	0.72	3.0(25)
^{95}Zr	1.23(3)	1.176(12)	1.68	0.97	5(3)
^{95}Nb	2.46(6)	2.456(25)	0.06	0.03	0(3)
^{125}Sb	5.51(11)	5.39(4)	1.04	0.55	2.3(22)
^{133}Ba	4.73(9)	4.79(4)	-0.61	-0.27	-1.2(21)
^{134}Cs	2.73(5)	2.736(19)	-0.10	-0.05	-0.2(20)
^{137}Cs	2.75(6)	2.632(18)	1.88	1.18	4.5(24)
^{152}Eu	2.36(5)	2.380(16)	-0.39	-0.19	-0.9(22)

Table B14 — Laboratory 22

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{89}Sr *3m*	16.0(20)	17.8(3)	-0.91	-0.83	-10(11)
^{89}Sr *e*	16(5)	17.8(3)	-0.34	-0.71	-1(3) × 10^{1}
^{90}Sr *3m*	7.5(9)	8.900(19)	-1.67	-2.00	-16(10)
^{90}Sr *e*	7.6(18) Q	8.900(19)	-0.72	-1.77	-14(20)
^{238}U	1.15(10)	1.24(3)	-0.88	-1.12	-7(8)
^{238}Pu	15.3(13)	15.28(5)	-0.01	-0.02	0(9)
^{239}Pu	13.0(11)	13.29(6)	-0.22	-0.41	-2(9)
^{241}Am	12.0(10)	11.99(4)	0.01	0.02	0(8)
^{3}H	492(25)	491(5)	0.02	0.02	0(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{89}Sr *3m*	9.4(10)	12.83(20)	-3.43 D	-2.81 D	-27(8)
^{89}Sr *e*	13(3)	12.83(20)	0.06	0.14	1(22)
^{90}Sr *3m*	9.3(8)	10.189(16)	-1.25	-1.29	-9(7)
^{90}Sr *e*	9.0(19) Q	10.189(16)	-0.65	-1.69	-12(19)
^{238}U	1.03(8)	1.059(24)	-0.35	-0.61	-3(8)
^{238}Pu	2.58(22)	2.607(9)	-0.12	-0.20	-1(9)
^{239}Pu	5.8(5)	6.06(3)	-0.62	-0.85	-5(8)
^{241}Am	3.7(3)	3.691(13)	0.00	0.00	0(8)

Table B15 — Laboratory 23

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	2.0(3)	3.718(14)	-5.72 D	-5.30 D	-46(8)
^{60}Co	11.6(4)	18.84(6)	-17.89 D	-8.60 D	-38.4(21)
^{88}Y	2.6(3)	3.843(14)	-4.14 D	-4.37 D	-32(8)
^{95}Zr	1.2(3)	1.836(19)	-2.12	-2.49	-35(16)
^{95}Nb	2.5(4)	3.84(4)	-3.32 D	-2.75 D	-35(10)
^{125}Sb	4.0(3)	6.48(4)	-8.20 D	-5.10 D	-38(5)
^{133}Ba	3.2(3)	5.74(4)	-8.40 D	-6.77 D	-44(5)
^{134}Cs	3.2(3)	5.30(4)	-6.95 D	-6.84 D	-40(6)
^{137}Cs	1.90(20)	2.884(20)	-4.90 D	-4.85 D	-34(7)
^{152}Eu	2.1(3)	4.19(3)	-6.94 D	-6.11 D	-50(7)

Table B16 – Laboratory 24

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.5(4)	3.718(14)	-0.58	-0.64	-6(10)
^{60}Co	19.3(8)	18.84(6)	0.63	0.56	3(4)
^{88}Y	3.86(22)	3.843(14)	0.08	0.06	0(6)
^{95}Zr	1.87(23)	1.836(19)	0.15	0.13	2(13)
^{125}Sb	6.3(4)	6.48(4)	-0.34	-0.29	-2(7)
^{133}Ba	5.5(4)	5.74(4)	-0.79	-0.78	-5(7)
^{134}Cs	5.5(5)	5.30(4)	0.35	0.54	3(9)
^{137}Cs	3.01(20)	2.884(20)	0.63	0.62	4(7)
^{152}Eu	4.0(3)	4.19(3)	-0.82	-0.65	-5(7)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.51(10)	2.498(9)	0.12	0.12	0(4)
^{60}Co	5.25(18)	5.094(16)	0.87	0.84	3(4)
^{88}Y	1.26(5)	1.204(5)	1.11	1.12	5(4)
^{95}Zr	1.26(6)	1.176(12)	1.38	1.51	7(5)
^{125}Sb	5.70(25)	5.39(4)	1.23	1.41	6(5)
^{133}Ba	5.0(3)	4.79(4)	0.73	0.99	5(7)
^{134}Cs	2.86(11)	2.736(19)	1.11	1.12	5(4)
^{137}Cs	2.86(16)	2.632(18)	1.41	2.28	9(6)
^{152}Eu	2.45(7)	2.380(16)	0.97	0.67	3(3)

Table B17 — Laboratory 25

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{90}Sr	7.2(6)	8.900(19)	-2.79 Q	-2.37	-19(7)
^{238}U	1.47(21)	1.24(3)	1.07	2.81 Q	19(17)
^{238}Pu	14.6(11)	15.28(5)	-0.66	-0.94	-5(7)
^{239}Pu	12.8(9)	13.29(6)	-0.52	-0.80	-4(7)
^{241}Am	11.9(7)	11.99(4)	-0.08	-0.10	0(6)
^{3}H	521(23)	491(5)	1.26	1.28	6(5)
^{14}C	143(9)	160.4(10)	-1.99	-1.38	-11(6)
^{35}S	402(20)	411.1(11)	-0.46	-0.33	-2(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	1.24(9)	2.498(9)	-13.91 D	-13.43 D	-50(4)
^{60}Co	5.08(22)	5.094(16)	-0.06	-0.07	0(5)
^{88}Y	1.32(8)	1.204(5)	1.44	2.32	10(7)
^{95}Zr	1.20(9)	1.176(12)	0.27	0.44	2(8)
^{95}Nb	2.58(12)	2.456(25)	1.01	1.01	5(5)
^{125}Sb	5.17(25)	5.39(4)	-0.86	-0.98	-4(5)
^{133}Ba	4.29(20)	4.79(4)	-2.45	-2.24	-10(5)
^{134}Cs	2.35(11)	2.736(19)	-3.45 D	-3.47 D	-14(4)
^{137}Cs	2.63(12)	2.632(18)	-0.02	-0.02	0(5)
^{152}Eu	1.82(10)	2.380(16)	-5.53 D	-5.39 D	-24(5)

Table B18 — Laboratory 26

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{239}Pu	13.8(5)	13.29(6)	0.98	0.82	4(4)
^{241}Am	29.7(9)	11.99(4)	19.02 D	29.54 D	148(8)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.7(7) Q	2.498(9)	0.26	1.94	$1(3) \times 10^1$
^{60}Co	5.07(15)	5.094(16)	-0.16	-0.13	0(3)
^{88}Y	1.18(2)	1.204(5)	-1.18	-0.49	-2.0(17)
^{95}Zr	1.18(1)	1.176(12)	0.28	0.08	0.4(13)
^{95}Nb	2.23(11)	2.456(25)	-2.00	-1.84	-9(5)
^{125}Sb	5.35(11)	5.39(4)	-0.32	-0.17	-0.7(22)
^{133}Ba	5.55(21)	4.79(4)	3.56 D	3.41 D	16(5)
^{134}Cs	3.41(9)	2.736(19)	7.33 D	6.07 D	25(4)
^{137}Cs	2.61(2)	2.632(18)	-0.83	-0.22	-0.8(10)
^{152}Eu	2.17(17)	2.380(16)	-1.23	-2.02	-9(7)

Table B19 — Laboratory 27

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	2.7(8)	3.718(14)	-1.27	-3.14 Q	-27(22)
^{60}Co	14(3)	18.84(6)	-1.70	-5.87 Q	-26(15)
^{88}Y	2.7(7)	3.843(14)	-1.63	-4.02 Q	-30(18)
^{95}Zr	1.0(5)	1.836(19)	-1.67	-3.27 Q	$-5(3) \times 10^1$
^{95}Nb	2.6(7)	3.84(4)	-1.76	-2.54	-32(18)
^{125}Sb	5.6(16)	6.48(4)	-0.55	-1.81	-14(25)
^{133}Ba	5.7(17)	5.74(4)	-0.02	-0.11	$0(3) \times 10^1$
^{134}Cs	3.3(7)	5.30(4)	-2.86 D	-6.52 D	-38(13)
^{137}Cs	2.9(9)	2.884(20)	0.02	0.08	$0(3) \times 10^1$
^{152}Eu	2.1(7)	4.19(3)	-2.99 D	-6.11 D	-50(17)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.3(5) Q	2.498(9)	-0.40	-2.12	-8(20)
^{60}Co	5.5(12) Q	5.094(16)	0.34	2.18	8(24)
^{88}Y	1.1(3) Q	1.204(5)	-0.35	-2.10	-9(25)
^{95}Zr	1.0(3)	1.176(12)	-0.58	-3.14 Q	$-1(3) \times 10^1$
^{95}Nb	2.2(8) Q	2.456(25)	-0.32	-2.09	$-1(4) \times 10^1$
^{125}Sb	6.3(13)	5.39(4)	0.70	4.11 Q	17(24)
^{133}Ba	6.3(13)	4.79(4)	1.16	6.77 Q	$3(3) \times 10^1$
^{134}Cs	2.8(6) Q	2.736(19)	0.11	0.58	2(22)
^{137}Cs	3.2(7)	2.632(18)	0.81	5.69 Q	$2(3) \times 10^1$
^{152}Eu	2.4(5) Q	2.380(16)	0.04	0.19	1(21)

Table B20 − Laboratory 28

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{55}Fe	18.8(16)	15.8(3)	1.83	2.18	19(10)
^{90}Sr	9.1(5)	8.900(19)	0.46	0.29	2(5)
^{238}U	1.5(7)	1.24(3)	0.37	2.89 Q	2(5) × 10^{1}
^{238}Pu	13.0(13)	15.28(5)	-1.73	-2.97 Q	-15(9)
^{239}Pu	15.7(9)	13.29(6)	2.74 D	3.88 D	18(7)
^{241}Am	12.2(17)	11.99(4)	0.13	0.35	2(14)
^{22}Na	3.3(3)	3.718(14)	-1.42	-1.23	-11(8)
^{60}Co	19.0(10)	18.84(6)	0.16	0.19	1(6)
^{88}Y	3.9(3)	3.843(14)	0.20	0.20	1(7)
^{95}Zr	1.8(3)	1.836(19)	-0.20	-0.22	-3(15)
^{95}Nb	4.2(4)	3.84(4)	1.07	0.71	9(9)
^{125}Sb	6.6(5)	6.48(4)	0.20	0.18	1(7)
^{133}Ba	5.1(3)	5.74(4)	-2.27	-1.71	-11(5)
^{134}Cs	4.8(4)	5.30(4)	-1.72	-1.80	-10(6)
^{137}Cs	3.04(25)	2.884(20)	0.62	0.77	5(9)
^{152}Eu	3.3(3)	4.19(3)	-2.96 Q	-2.52	-21(7)
^{3}H	565(23)	491(5)	3.12 D	3.19 D	15(5)
^{35}S	46(9) × 10^{1}	411.1(11)	0.49	1.67	11(23)
	(Bq g^{-1})	(Bq g^{-1})			
^{90}Sr	11.3(13)	10.189(16)	0.85	1.53	11(13)
^{238}U	0.92(4)	1.059(24)	-3.37 D	-3.02 D	-13(4)
^{238}Pu	2.5(3)	2.607(9)	-0.42	-0.92	-5(12)
^{239}Pu	5.3(4)	6.06(3)	-1.87	-2.28	-12(7)
^{241}Am	3.75(20)	3.691(13)	0.30	0.32	2(6)
^{22}Na	2.28(12)	2.498(9)	-1.81	-2.33	-9(5)
^{60}Co	5.24(25)	5.094(16)	0.58	0.79	3(5)
^{88}Y	1.21(9)	1.204(5)	0.06	0.11	0(8)
^{95}Zr	1.25(8)	1.176(12)	0.92	1.33	6(7)
^{95}Nb	2.37(12)	2.456(25)	-0.70	-0.70	-3(5)
^{125}Sb	5.35(25)	5.39(4)	-0.15	-0.17	-1(5)
^{133}Ba	4.35(21)	4.79(4)	-2.06	-1.97	-9(5)
^{134}Cs	2.45(18)	2.736(19)	-1.58	-2.57	-10(7)
^{137}Cs	2.75(14)	2.632(18)	0.83	1.18	4(6)
^{154}Eu	2.20(12)	0.0072(11)	–	–	–

Table B21 – Laboratory 29

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{90}Sr	9.2(4)	8.900(19)	0.75	0.42	3(5)
^{238}U	1.04(5)	1.24(3)	-3.47 Q	-2.46	-16(5)
^{238}Pu	14.3(8)	15.28(5)	-1.22	-1.29	-6(5)
^{239}Pu	13.1(6)	13.29(6)	-0.31	-0.31	-1(5)
^{241}Am	13.0(6)	11.99(4)	1.68	1.69	8(5)
^{22}Na	3.3(3)	3.718(14)	-1.39	-1.29	-11(8)
^{60}Co	19.8(15)	18.84(6)	0.64	1.14	5(8)
^{88}Y	4.0(4)	3.843(14)	0.39	0.55	4(10)
^{95}Zr	1.7(3)	1.836(19)	-0.45	-0.53	-7(16)
^{95}Nb	3.9(6)	3.84(4)	0.11	0.13	2(16)
^{125}Sb	6.7(6)	6.48(4)	0.37	0.45	3(9)
^{133}Ba	5.4(5)	5.74(4)	-0.68	-0.91	-6(9)
^{134}Cs	5.1(4)	5.30(4)	-0.51	-0.66	-4(8)
^{137}Cs	3.0(3)	2.884(20)	0.39	0.57	4(10)
^{152}Eu	4.3(4)	4.19(3)	0.27	0.31	3(10)
^{3}H	490(10)	491(5)	-0.13	-0.06	-0.3(23)

Table B22 – Laboratory 32

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.41(15)	3.718(14)	-2.04	-0.95	-8(4)
^{60}Co	18.9(4)	18.84(6)	0.06	0.03	0.1(19)
^{88}Y	4.12(14)	3.843(14)	1.97	0.97	7(4)
^{95}Zr	2.14(19)	1.836(19)	1.59	1.19	17(10)
^{95}Nb	3.86(13)	3.84(4)	0.18	0.05	1(4)
^{125}Sb	7.0(3)	6.48(4)	1.60	1.03	8(5)
^{133}Ba	5.40(17)	5.74(4)	-1.96	-0.91	-6(3)
^{134}Cs	4.96(13)	5.30(4)	-2.52	-1.12	-6(3)
^{137}Cs	3.07(15)	2.884(20)	1.23	0.92	6(6)
^{152}Eu	4.8(4)	4.19(3)	1.48	1.68	14(9)
^{3}H *d*	466(18)	491(5)	-1.36	-1.10	-5(4)
^{3}H *c*	$47(6) \times 10^{1}$	491(5)	-0.30	-0.80	-4(13)
^{14}C	130(20)	160.4(10)	-1.52	-2.41	-19(12)
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	7.7(6)	6.89(12)	1.26	1.45	11(9)
^{89}Sr	14.4(13)	12.83(20)	1.20	1.29	12(10)
^{90}Sr	10.1(9)	10.189(16)	-0.09	-0.11	-1(9)
^{238}U	1.04(4)	1.059(24)	-0.38	-0.36	-2(5)
^{238}Pu	2.81(11)	2.607(9)	1.84	1.47	8(5)
^{239}Pu	6.46(24)	6.06(3)	1.65	1.21	7(4)
^{241}Am	3.63(11)	3.691(13)	-0.55	-0.33	-2(3)

Table B23 – Laboratory 34

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{55}Fe	15.2(13)	15.8(3)	-0.49	-0.49	-4(9)
^{238}U	1.21(6)	1.24(3)	-0.48	-0.39	-3(6)
^{238}Pu	15.6(8)	15.28(5)	0.40	0.42	2(5)
^{239}Pu	13.5(7)	13.29(6)	0.30	0.35	2(6)
^{241}Am	13.4(7)	11.99(4)	2.01	2.36	12(6)
^{22}Na	3.3(4)	3.718(14)	-1.11	-1.16	-10(9)
^{60}Co	19.9(20)	18.84(6)	0.53	1.26	6(11)
^{88}Y	4.0(4)	3.843(14)	0.49	0.69	5(10)
^{95}Zr	2.31(25)	1.836(19)	1.89	1.86	26(14)
^{113}Sn	0.44(11)	–	–	–	–
^{125}Sb	6.3(6)	6.48(4)	-0.32	-0.41	-3(10)
^{133}Ba	5.4(7)	5.74(4)	-0.43	-0.83	-5(13)
^{134}Cs	5.2(3)	5.30(4)	-0.33	-0.30	-2(6)
^{137}Cs	3.04(16)	2.884(20)	0.97	0.77	5(6)
^{152}Eu	3.7(4)	4.19(3)	-1.32	-1.47	-12(9)
^{3}H	55(4) × 10^1	491(5)	1.57	2.33	11(7)
^{14}C	238(19)	160.4(10)	4.15 D	6.17 D	48(12)
^{35}S	237(16)	411.1(11)	-10.68 D	-6.34 D	-42(4)

Table B24 – Laboratory 35

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{89}Sr	13.6(6)	17.8(3)	-6.12 Q	-1.95	-24(4)
^{90}Sr	5.65(17)	8.900(19)	-19.00 D	-4.54 D	-36.5(19)
^{238}U	1.31(4)	1.24(3)	1.30	0.78	5(4)
^{238}Pu	14.8(5)	15.28(5)	-1.06	-0.66	-3(3)
^{239}Pu	14.0(5)	13.29(6)	1.48	1.10	5(4)
^{22}Na	3.3(4)	3.718(14)	-0.95	-1.23	-11(11)
^{60}Co	19.8(8)	18.84(6)	1.30	1.14	5(4)
^{88}Y	3.8(4)	3.843(14)	-0.22	-0.29	-2(10)
^{95}Nb	3.9(5)	3.84(4)	0.13	0.13	2(13)
^{125}Sb	7.6(9)	6.48(4)	1.26	2.37	18(14)
^{133}Ba	5.1(4)	5.74(4)	-1.66	-1.74	-11(7)
^{134}Cs	4.9(4)	5.30(4)	-1.16	-1.21	-7(6)
^{137}Cs	3.2(4)	2.884(20)	0.88	1.66	12(13)
^{152}Eu	3.7(5)	4.19(3)	-1.13	-1.55	-13(11)
^{3}H *d*	52(4) × 10^{1}	491(5)	0.58	1.02	5(8)
^{3}H *c*	52(6) × 10^{1}	491(5)	0.47	1.24	6(12)
^{14}C	170(17)	160.4(10)	0.56	0.76	6(11)
^{35}S	285(15)	411.1(11)	-8.39 D	-4.59 D	-31(4)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.34(7)	2.498(9)	-2.24	-1.69	-6(3)
^{60}Co	5.27(15)	5.094(16)	1.17	0.95	3(3)
^{88}Y	1.21(4)	1.204(5)	0.14	0.11	0(4)
^{95}Zr	1.25(4)	1.176(12)	1.78	1.33	6(4)
^{95}Nb	2.63(7)	2.456(25)	2.34	1.42	7(3)
^{125}Sb	5.23(15)	5.39(4)	-1.02	-0.71	-3(3)
^{133}Ba	4.15(13)	4.79(4)	-4.70 D	-2.87 D	-13(3)
^{134}Cs	2.57(7)	2.736(19)	-2.28	-1.49	-6(3)
^{137}Cs	2.81(8)	2.632(18)	2.17	1.78	7(3)
^{152}Eu	2.23(6)	2.380(16)	-2.42	-1.44	-6(3)

Table B25 – Laboratory 36

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{3}H	484(22)	491(5)	-0.33	-0.32	-2(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{90}Sr	11.6(5)	10.189(16)	2.74 Q	1.88	13(5)
^{22}Na	2.28(4)	2.498(9)	-5.32 Q	-2.33	-8.7(16)
^{60}Co	4.90(9)	5.094(16)	-2.12	-1.04	-3.8(18)
^{88}Y	1.19(3)	1.204(5)	-0.47	-0.29	-1.2(25)
^{95}Zr	1.14(7)	1.176(12)	-0.50	-0.64	-3(6)
^{95}Nb	4.33(9)	2.456(25)	20.06 D	15.30 D	76(4)
^{125}Sb	5.50(14)	5.39(4)	0.77	0.51	2(3)
^{133}Ba	4.67(19)	4.79(4)	-0.62	-0.54	-2(4)
^{134}Cs	2.70(5)	2.736(19)	-0.66	-0.32	-1.3(20)
^{137}Cs	2.61(5)	2.632(18)	-0.42	-0.22	-0.8(20)
^{152}Eu	2.32(11)	2.380(16)	-0.54	-0.58	-3(5)

Table B26 – Laboratory 38

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{3}H *d*	497(15)	491(5)	0.35	0.24	1(4)
^{3}H *c*	525(15)	491(5)	2.12	1.45	7(4)
^{14}C	161(11)	160.4(10)	0.05	0.05	0(7)
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	6.4(3)	6.89(12)	-1.85	-1.00	-8(4)
^{89}Sr	11.0(5)	12.83(20)	-3.39 Q	-1.50	-14(4)
^{90}Sr	9.43(22)	10.189(16)	-3.44 Q	-1.04	-7.4(22)
^{238}U	1.03(9)	1.059(24)	-0.31	-0.61	-3(9)
^{238}Pu	2.77(9)	2.607(9)	1.80	1.18	6(4)
^{239}Pu	6.39(13)	6.06(3)	2.47	1.00	5.4(22)
^{241}Am	3.57(18)	3.691(13)	-0.67	-0.65	-3(5)
^{22}Na	2.51(7)	2.498(9)	0.17	0.12	0(3)
^{60}Co	5.22(14)	5.094(16)	0.90	0.68	2(3)
^{88}Y	1.20(15)	1.204(5)	-0.03	-0.09	0(12)
^{95}Zr	1.23(4)	1.176(12)	1.30	0.97	5(4)
^{95}Nb	1.22(6)	2.456(25)	-19.01 D	-10.09 D	-50.3(25)
^{125}Sb	5.26(15)	5.39(4)	-0.82	-0.58	-2(3)
^{133}Ba	4.7(3)	4.79(4)	-0.32	-0.45	-2(7)
^{134}Cs	2.77(7)	2.736(19)	0.48	0.31	1(3)
^{137}Cs	2.66(8)	2.632(18)	0.34	0.28	1(3)
^{152}Eu	2.39(7)	2.380(16)	0.14	0.09	0(3)

Table B27 – Laboratory 40

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{90}Sr	14(3)	8.900(19)	1.83	6.70 Q	5(3) × 10^{1}
^{238}U	1.26(8)	1.24(3)	0.20	0.22	1(7)
^{238}Pu	14.8(4)	15.28(5)	-1.21	-0.63	-3(3)
^{239}Pu	12.9(4)	13.29(6)	-1.14	-0.64	-3(3)
^{241}Am	12.9(4)	11.99(4)	2.82 Q	1.52	8(3)
^{22}Na	3.1(7)	3.718(14)	-0.89	-2.00	-17(20)
^{57}Co	1.2(3)	–	–	–	–
^{60}Co	20(5)	18.84(6)	0.16	0.91	4(25)
^{88}Y	4.0(10)	3.843(14)	0.17	0.59	4(25)
^{95}Zr	1.9(5)	1.836(19)	0.08	0.13	2(25)
^{95}Nb	5.3(13)	3.84(4)	1.17	3.06 Q	4(4) × 10^{1}
^{125}Sb	6.6(16)	6.48(4)	0.09	0.31	2(25)
^{133}Ba	5.6(13)	5.74(4)	-0.13	-0.46	-3(23)
^{134}Cs	6.2(15)	5.30(4)	0.59	2.85 Q	2(3) × 10^{1}
^{137}Cs	3.4(8)	2.884(20)	0.60	2.39	2(3) × 10^{1}
^{3}H	448(14)	491(5)	-2.89 Q	-1.88	-9(3)

Table B28 – Laboratory 41

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{238}Pu	14.8(6)	15.28(5)	-0.91	-0.70	-3(4)
^{239}Pu	13.3(5)	13.29(6)	-0.07	-0.06	0(4)
^{241}Am	11.8(5)	11.99(4)	-0.46	-0.35	-2(4)
^{22}Na	3.3(5)	3.718(14)	-0.86	-1.26	-11(13)
^{57}Co	1(4)	–	–	–	–
^{60}Co	18.9(7)	18.84(6)	0.08	0.06	0(4)
^{88}Y	3.7(8)	3.843(14)	-0.24	-0.64	-5(20)
^{95}Nb	8.7(20)	3.84(4)	2.45	10.06 Q	13(5) × 10^{1}
^{125}Sb	5.0(12)	6.48(4)	-1.23	-2.96 Q	-22(18)
^{133}Ba	4.7(5)	5.74(4)	-2.13	-2.85 Q	-19(9)
^{134}Cs	5.7(7)	5.30(4)	0.51	1.13	7(13)
^{137}Cs	3.4(6)	2.884(20)	0.84	2.54	18(21)
^{3}H	434(13)	491(5)	-4.10 Q	-2.49	-12(3)

Table B29 – Laboratory 42

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{241}Am	12.9(15)	11.99(4)	0.59	1.46	7(12)
^{22}Na	3.7(6)	3.718(14)	0.04	0.07	1(16)
^{57}Co	1.25(21)	–	–	–	–
^{60}Co	20.6(22)	18.84(6)	0.80	2.09	9(12)
^{88}Y	4.3(6)	3.843(14)	0.82	1.64	12(15)
^{95}Zr	2.5(5)	1.836(19)	1.40	2.52	35(25)
^{95}Nb	4.2(6)	3.84(4)	0.57	0.69	9(15)
^{125}Sb	7.2(9)	6.48(4)	0.71	1.38	10(15)
^{133}Ba	5.2(6)	5.74(4)	-0.95	-1.52	-10(10)
^{134}Cs	5.1(6)	5.30(4)	-0.38	-0.73	-4(11)
^{137}Cs	2.7(5)	2.884(20)	-0.44	-0.96	-7(15)

Table B30 – Laboratory 45

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.4(5)	3.718(14)	-0.61	-0.95	-8(13)
^{60}Co	17.6(12)	18.84(6)	-1.09	-1.51	-7(6)
^{88}Y	4.0(6)	3.843(14)	0.28	0.52	4(14)
^{95}Nb	3.4(4)	3.84(4)	-1.06	-0.88	-11(10)
^{125}Sb	6.7(19)	6.48(4)	0.14	0.53	$0(3) \times 10^1$
^{133}Ba	5.1(8)	5.74(4)	-0.88	-1.76	-12(13)
^{134}Cs	5.7(6)	5.30(4)	0.58	1.16	7(12)
^{137}Cs	2.4(3)	2.884(20)	-1.78	-2.63 Q	-19(10)
^{152}Eu	3.7(8)	4.19(3)	-0.61	-1.44	-12(19)

Table B31 – Laboratory 46

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.70(21)	3.718(14)	-0.08	-0.05	0(6)
^{60}Co	18.1(8)	18.84(6)	-0.85	-0.85	-4(5)
^{88}Y	4.2(3)	3.843(14)	1.36	1.29	10(7)
^{95}Zr	2.5(4)	1.836(19)	1.98	2.48	35(17)
^{125}Sb	6.6(4)	6.48(4)	0.28	0.25	2(7)
^{133}Ba	6.1(4)	5.74(4)	1.11	0.95	6(6)
^{134}Cs	5.5(3)	5.30(4)	0.52	0.48	3(6)
^{137}Cs	3.26(22)	2.884(20)	1.70	1.85	13(8)
^{152}Eu	4.02(25)	4.19(3)	-0.69	-0.50	-4(6)
^{35}S	420(23)	411.1(11)	0.39	0.32	2(6)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.49(10)	2.498(9)	-0.08	-0.09	0(4)
^{60}Co	5.10(21)	5.094(16)	0.03	0.03	0(4)
^{88}Y	1.21(5)	1.204(5)	0.11	0.11	0(4)
^{95}Zr	1.17(5)	1.176(12)	-0.11	-0.10	0(5)
^{125}Sb	5.35(22)	5.39(4)	-0.17	-0.17	-1(4)
^{133}Ba	4.76(19)	4.79(4)	-0.15	-0.13	-1(4)
^{134}Cs	2.68(11)	2.736(19)	-0.50	-0.50	-2(4)
^{137}Cs	2.62(11)	2.632(18)	-0.11	-0.12	0(5)
^{152}Eu	2.45(11)	2.380(16)	0.63	0.67	3(5)

Table B32 – Laboratory 47

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{238}U *a*	1.17(12)	1.24(3)	-0.58	-0.88	-6(10)
^{238}U *m*	1.15(5)	1.24(3)	-1.47	-1.07	-7(5)
^{238}Pu	15.9(8)	15.28(5)	0.82	0.82	4(5)
^{239}Pu	13.2(6)	13.29(6)	-0.10	-0.10	0(5)
^{241}Am	11.7(10)	11.99(4)	-0.26	-0.43	-2(8)
^{22}Na	3.1(3)	3.718(14)	-2.17	-1.87	-16(8)
^{60}Co	18.1(9)	18.84(6)	-0.75	-0.84	-4(5)
^{88}Y	3.83(25)	3.843(14)	-0.05	-0.05	0(7)
^{95}Zr	1.69(21)	1.836(19)	-0.69	-0.57	-8(11)
^{95}Nb	3.43(19)	3.84(4)	-2.09	-0.83	-11(5)
^{125}Sb	6.2(4)	6.48(4)	-0.71	-0.52	-4(6)
^{133}Ba	5.45(23)	5.74(4)	-1.25	-0.78	-5(4)
^{134}Cs	4.97(20)	5.30(4)	-1.63	-1.08	-6(4)
^{137}Cs	2.87(21)	2.884(20)	-0.07	-0.07	0(7)
^{152}Eu	4.1(3)	4.19(3)	-0.51	-0.39	-3(6)
	(Bq g^{-1})	(Bq g^{-1})			
^{238}U	0.97(5)	1.059(24)	-1.72	-1.98	-9(5)
^{238}Pu	2.57(9)	2.607(9)	-0.38	-0.24	-1(4)
^{239}Pu	6.1(3)	6.06(3)	-0.04	-0.03	0(5)
^{241}Am	4.0(5)	3.691(13)	0.72	1.69	9(12)
^{22}Na	2.1(3)	2.498(9)	-1.53	-4.25 Q	-16(10)
^{60}Co	5.4(5)	5.094(16)	0.72	1.86	7(9)
^{88}Y	1.28(10)	1.204(5)	0.76	1.52	6(8)
^{95}Zr	1.22(9)	1.176(12)	0.49	0.79	4(8)
^{95}Nb	2.51(18)	2.456(25)	0.30	0.44	2(8)
^{125}Sb	5.4(4)	5.39(4)	-0.08	-0.13	-1(7)
^{133}Ba	4.7(3)	4.79(4)	-0.35	-0.49	-2(7)
^{134}Cs	2.83(19)	2.736(19)	0.49	0.85	3(7)
^{137}Cs	2.71(18)	2.632(18)	0.43	0.78	3(7)
^{152}Eu	2.36(16)	2.380(16)	-0.13	-0.19	-1(7)

Table B33 – Laboratory 48

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{14}C	10(5) × 10^{1}	160.4(10)	-1.28	-4.79 Q	-4(3) × 10^{1}
^{35}S	30(3) × 10^{1}	411.1(11)	-4.11 D	-4.04 D	-27(7)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	1.95(2)	2.498(9)	-25.00 D	-5.85 D	-21.9(9)
^{60}Co	4.77(5)	5.094(16)	-6.16 Q	-1.74	-6.4(10)
^{88}Y	1.15(1)	1.204(5)	-4.87 Q	-1.09	-4.5(9)
^{95}Zr	0.66(1)	1.176(12)	-33.01 D	-9.21 D	-43.9(10)
^{95}Nb	2.37(3)	2.456(25)	-2.20	-0.70	-3.5(16)
^{125}Sb	4.91(6)	5.39(4)	-6.63 Q	-2.15	-8.9(13)
^{133}Ba	3.80(5)	4.79(4)	-15.45 D	-4.43 D	-20.7(12)
^{134}Cs	2.36(3)	2.736(19)	-10.58 D	-3.38 D	-13.7(12)
^{137}Cs	2.68(3)	2.632(18)	1.36	0.48	1.8(13)
^{152}Eu	2.09(3)	2.380(16)	-8.54 D	-2.79 D	-12.2(14)

Table B34 – Laboratory 49

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{3}H	432(5)	491(5)	-8.79 D	-2.59 D	-12.2(13)
^{14}C	157(3)	160.4(10)	-0.98	-0.24	-1.9(19)
	(Bq g^{-1})	(Bq g^{-1})			
^{90}Sr	9.0(7)	10.189(16)	-1.93	-1.70	-12(6)
^{238}Pu	1.52(5)	2.607(9)	-20.99 D	-7.87 D	-41.7(20)
^{239}Pu	4.0(4)	6.06(3)	-5.01 D	-6.25 D	-34(7)
^{22}Na	2.22(12)	2.498(9)	-2.31	-2.97 Q	-11(5)
^{60}Co	4.98(25)	5.094(16)	-0.45	-0.61	-2(5)
^{88}Y	1.23(7)	1.204(5)	0.36	0.51	2(6)
^{95}Zr	1.15(7)	1.176(12)	-0.36	-0.46	-2(6)
^{95}Nb	4.46(24)	2.456(25)	8.31 D	16.36 D	82(10)
^{125}Sb	5.5(3)	5.39(4)	0.49	0.64	3(6)
^{133}Ba	4.8(3)	4.79(4)	0.19	0.23	1(6)
^{134}Cs	2.55(13)	2.736(19)	-1.41	-1.67	-7(5)
^{137}Cs	2.73(14)	2.632(18)	0.69	0.98	4(6)
^{152}Eu	2.26(12)	2.380(16)	-0.99	-1.16	-5(5)

Table B35 – Laboratory 50

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.39(8)	2.498(9)	-1.35	-1.16	-4(4)
^{60}Co	5.11(15)	5.094(16)	0.11	0.09	0(3)
^{88}Y	1.19(4)	1.204(5)	-0.36	-0.29	-1(4)
^{95}Zr	1.22(4)	1.176(12)	1.06	0.79	4(4)
^{95}Nb	2.41(13)	2.456(25)	-0.35	-0.37	-2(6)
^{125}Sb	5.34(22)	5.39(4)	-0.21	-0.22	-1(4)
^{133}Ba	4.71(18)	4.79(4)	-0.43	-0.36	-2(4)
^{134}Cs	2.60(8)	2.736(19)	-1.65	-1.22	-5(3)
^{137}Cs	2.70(9)	2.632(18)	0.74	0.68	3(4)
^{152}Eu	2.38(8)	2.380(16)	0.00	0.00	0(4)

Table B36 – Laboratory 51

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.5(2)	3.718(14)	-1.09	-0.67	-6(6)
^{60}Co	19.7(10)	18.84(6)	0.86	1.02	5(6)
^{88}Y	4.2(2)	3.843(14)	1.78	1.25	9(5)
^{95}Zr	2.1(3)	1.836(19)	0.88	1.03	14(16)
^{95}Nb	4.7(10)	3.84(4)	0.86	1.78	$2(3) \times 10^1$
^{125}Sb	6.8(3)	6.48(4)	1.06	0.66	5(5)
^{133}Ba	5.9(3)	5.74(4)	0.52	0.42	3(6)
^{134}Cs	5.6(3)	5.30(4)	0.98	0.97	6(6)
^{137}Cs	2.9(1)	2.884(20)	0.15	0.08	1(4)
^{152}Eu	4.2(2)	4.19(3)	0.03	0.02	0(5)

Table B37 – Laboratory 52

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	4.0(3)	3.718(14)	1.04	0.87	8(7)
^{60}Co	19.4(9)	18.84(6)	0.62	0.67	3(5)
^{88}Y	3.9(3)	3.843(14)	0.20	0.20	1(8)
^{95}Zr	2.1(4)	1.836(19)	0.69	1.03	14(21)
^{95}Nb	6.5(4)	3.84(4)	6.47 D	5.49 D	69(11)
^{125}Sb	7.2(5)	6.48(4)	1.41	1.48	11(8)
^{133}Ba	5.8(3)	5.74(4)	0.18	0.15	1(6)
^{134}Cs	5.5(3)	5.30(4)	0.70	0.64	4(6)
^{137}Cs	3.00(19)	2.884(20)	0.61	0.57	4(7)
^{152}Eu	4.4(3)	4.19(3)	0.50	0.46	4(8)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.48(10)	2.498(9)	-0.18	-0.20	-1(4)
^{60}Co	5.23(21)	5.094(16)	0.65	0.73	3(4)
^{88}Y	1.21(5)	1.204(5)	0.11	0.11	0(4)
^{95}Zr	1.22(5)	1.176(12)	0.86	0.79	4(5)
^{95}Nb	3.65(15)	2.456(25)	7.85 D	9.75 D	49(6)
^{125}Sb	5.16(21)	5.39(4)	-1.07	-1.03	-4(4)
^{133}Ba	4.75(19)	4.79(4)	-0.20	-0.18	-1(4)
^{134}Cs	2.86(12)	2.736(19)	1.02	1.12	5(5)
^{137}Cs	2.76(12)	2.632(18)	1.05	1.28	5(5)
^{152}Eu	2.35(10)	2.380(16)	-0.30	-0.29	-1(5)

Table B38 – Laboratory 53

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	4.10(20)	3.718(14)	1.91	1.18	10(6)
^{60}Co	19.0(6)	18.84(6)	0.27	0.19	1(4)
^{88}Y	4.00(20)	3.843(14)	0.78	0.55	4(5)
^{95}Zr	1.80(20)	1.836(19)	-0.18	-0.14	-2(11)
^{95}Nb	6.1(6)	3.84(4)	3.77 D	4.66 D	59(16)
^{125}Sb	6.4(7)	6.48(4)	-0.11	-0.17	-1(11)
^{133}Ba	5.40(20)	5.74(4)	-1.68	-0.91	-6(4)
^{134}Cs	5.40(24)	5.30(4)	0.40	0.32	2(5)
^{137}Cs	3.10(14)	2.884(20)	1.53	1.06	7(5)
^{152}Eu	4.10(20)	4.19(3)	-0.46	-0.27	-2(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.48(9)	2.498(9)	-0.20	-0.20	-1(4)
^{60}Co	5.23(16)	5.094(16)	0.85	0.73	3(4)
^{88}Y	1.21(5)	1.204(5)	0.11	0.11	0(4)
^{95}Zr	1.14(5)	1.176(12)	-0.69	-0.64	-3(5)
^{95}Nb	3.55(12)	2.456(25)	8.93 D	8.93 D	45(5)
^{125}Sb	5.17(19)	5.39(4)	-1.12	-0.98	-4(4)
^{133}Ba	4.41(16)	4.79(4)	-2.30	-1.70	-8(4)
^{134}Cs	2.74(8)	2.736(19)	0.05	0.04	0(3)
^{137}Cs	2.59(10)	2.632(18)	-0.42	-0.42	-2(4)
^{152}Eu	2.23(10)	2.380(16)	-1.48	-1.44	-6(5)

Table B39 – Laboratory 54

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.12(15)	3.718(14)	-3.97 Q	-1.84	-16(4)
^{57}Co	1.5(4)	–	–	–	–
^{60}Co	16.9(6)	18.84(6)	-3.03 Q	-2.28	-10(4)
^{88}Y	3.48(21)	3.843(14)	-1.73	-1.28	-9(6)
^{95}Zr	1.77(22)	1.836(19)	-0.30	-0.26	-4(12)
^{95}Nb	6.4(4)	3.84(4)	6.81 D	5.22 D	66(10)
^{125}Sb	6.5(5)	6.48(4)	0.02	0.02	0(7)
^{133}Ba	5.3(4)	5.74(4)	-1.20	-1.10	-7(6)
^{134}Cs	4.86(22)	5.30(4)	-1.98	-1.44	-8(5)
^{137}Cs	2.76(14)	2.884(20)	-0.88	-0.61	-4(5)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.42(7)	2.498(9)	-1.11	-0.84	-3(3)
^{57}Co	0.97(6)	–	–	–	–
^{60}Co	5.12(16)	5.094(16)	0.16	0.14	1(4)
^{88}Y	1.21(4)	1.204(5)	0.14	0.11	0(4)
^{95}Zr	1.22(4)	1.176(12)	1.06	0.79	4(4)
^{95}Nb	4.75(14)	2.456(25)	16.13 D	18.73 D	93(6)
^{125}Sb	5.5(3)	5.39(4)	0.52	0.69	3(6)
^{133}Ba	4.08(19)	4.79(4)	-3.65 D	-3.18 D	-15(4)
^{134}Cs	2.83(10)	2.736(19)	0.93	0.85	3(4)
^{137}Cs	2.76(10)	2.632(18)	1.26	1.28	5(4)

Table B40 – Laboratory 55

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{3}H	498(18)	491(5)	0.35	0.28	1(4)
^{14}C	21(4) × 10^{1}	160.4(10)	1.25	3.81 Q	30(24)
^{35}S	42(4) × 10^{1}	411.1(11)	0.23	0.32	2(9)
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	7.0(7)	6.89(12)	0.18	0.24	2(11)
^{89}Sr	9.7(6)	12.83(20)	-4.82 Q	-2.57	-24(5)
^{90}Sr	9.9(7)	10.189(16)	-0.47	-0.43	-3(7)
^{238}U	1.026(1)	1.059(24)	-1.37	-0.69	-3.1(22)
^{238}Pu	2.51(13)	2.607(9)	-0.74	-0.69	-4(5)
^{239}Pu	6.0(3)	6.06(3)	-0.27	-0.24	-1(5)
^{241}Am	3.8(4)	3.691(13)	0.35	0.79	4(11)
^{22}Na	2.33(23)	2.498(9)	-0.73	-1.80	-7(9)
^{60}Co	5.11(21)	5.094(16)	0.08	0.09	0(4)
^{88}Y	1.20(6)	1.204(5)	-0.07	-0.09	0(5)
^{95}Zr	1.18(7)	1.176(12)	0.06	0.08	0(6)
^{95}Nb	2.48(12)	2.456(25)	0.20	0.20	1(5)
^{125}Sb	5.3(3)	5.39(4)	-0.27	-0.35	-1(6)
^{133}Ba	4.63(25)	4.79(4)	-0.63	-0.72	-3(6)
^{134}Cs	2.74(13)	2.736(19)	0.03	0.04	0(5)
^{137}Cs	2.62(12)	2.632(18)	-0.10	-0.12	0(5)
^{152}Eu	2.45(12)	2.380(16)	0.58	0.67	3(5)

Table B41 – Laboratory 56

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{89}Sr	2.3(4)	17.8(3)	-33.75 D	-7.09 D	-87.2(20)
^{90}Sr	1.74(14)	8.900(19)	-50.68 D	-10.00 D	-80.4(16)
^{238}U	1.16(5)	1.24(3)	-1.41	-1.00	-7(5)
^{238}Pu	14.7(6)	15.28(5)	-1.01	-0.76	-4(4)
^{239}Pu	13.0(5)	13.29(6)	-0.56	-0.48	-2(4)
^{22}Na	3.91(21)	3.718(14)	0.91	0.59	5(6)
^{60}Co	21.1(8)	18.84(6)	2.82 D	2.69 D	12(5)
^{88}Y	3.8(3)	3.843(14)	-0.23	-0.22	-2(7)
^{95}Zr	2.10(16)	1.836(19)	1.64	1.03	14(9)
^{95}Nb	4.4(6)	3.84(4)	1.02	1.16	15(14)
^{125}Sb	7.1(5)	6.48(4)	1.23	1.30	10(8)
^{133}Ba	5.4(4)	5.74(4)	-0.93	-0.99	-6(7)
^{134}Cs	5.3(3)	5.30(4)	-0.08	-0.08	0(5)
^{137}Cs	3.35(17)	2.884(20)	2.72 Q	2.30	16(6)
^{152}Eu	4.35(16)	4.19(3)	0.96	0.46	4(4)
^{3}H	471(9)	491(5)	-2.02	-0.89	-4.2(20)

Table B42 – Laboratory 57

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.26(3)	2.498(9)	-7.61 Q	-2.54	-9.5(12)
^{60}Co	5.09(4)	5.094(16)	-0.08	-0.02	-0.1(9)
^{88}Y	1.15(2)	1.204(5)	-2.64 Q	-1.09	-4.5(17)
^{95}Zr	1.69(2)	1.176(12)	22.05 D	9.19 D	43.8(22)
^{125}Sb	4.87(4)	5.39(4)	-9.15 Q	-2.33	-9.6(10)
^{133}Ba	4.51(3)	4.79(4)	-5.59 Q	-1.25	-5.8(10)
^{134}Cs	2.51(2)	2.736(19)	-8.18 Q	-2.03	-8.2(10)
^{137}Cs	2.71(3)	2.632(18)	2.22	0.78	3.0(13)
^{152}Eu	2.29(2)	2.380(16)	-3.52 Q	-0.87	-3.8(11)

Table B43 – Laboratory 58

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.05(17)	3.718(14)	-3.91 Q	-2.06	-18(5)
^{60}Co	15.8(5)	18.84(6)	-6.28 D	-3.61 D	-16(3)
^{88}Y	2.98(17)	3.843(14)	-5.06 D	-3.03 D	-22(5)
^{95}Zr	1.51(21)	1.836(19)	-1.55	-1.28	-18(11)
^{95}Nb	2.5(4)	3.84(4)	-4.08 D	-2.79 D	-35(9)
^{125}Sb	5.10(15)	6.48(4)	-8.89 D	-2.84 D	-21.3(24)
^{133}Ba	4.79(16)	5.74(4)	-5.77 Q	-2.54	-17(3)
^{134}Cs	4.31(18)	5.30(4)	-5.39 D	-3.23 D	-19(4)
^{137}Cs	2.50(13)	2.884(20)	-2.92 Q	-1.89	-13(5)
^{152}Eu	3.69(11)	4.19(3)	-4.41 Q	-1.47	-12(3)

Table B44 – Laboratory 59

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	7.0(4)	6.89(12)	0.39	0.27	2(6)
^{90}Sr	12.5(5)	10.189(16)	4.65 D	3.20 D	23(5)
^{238}U	1.03(13)	1.059(24)	-0.22	-0.61	-3(12)
^{238}Pu	2.5(3)	2.607(9)	-0.21	-0.43	-2(11)
^{239}Pu	5.9(7)	6.06(3)	-0.21	-0.41	-2(11)
^{241}Am	3.6(4)	3.691(13)	-0.13	-0.28	-1(11)
^{22}Na	2.40(14)	2.498(9)	-0.70	-1.05	-4(6)
^{60}Co	5.0(3)	5.094(16)	-0.25	-0.39	-1(6)
^{88}Y	1.18(7)	1.204(5)	-0.35	-0.49	-2(6)
^{95}Zr	1.15(7)	1.176(12)	-0.36	-0.46	-2(6)
^{95}Nb	1.80(10)	2.456(25)	-6.36 D	-5.36 D	-27(4)
^{125}Sb	5.2(3)	5.39(4)	-0.55	-0.76	-3(6)
^{133}Ba	4.7(3)	4.79(4)	-0.51	-0.63	-3(6)
^{134}Cs	2.60(15)	2.736(19)	-0.90	-1.22	-5(6)
^{137}Cs	2.59(15)	2.632(18)	-0.28	-0.42	-2(6)
^{152}Eu	2.33(13)	2.380(16)	-0.38	-0.48	-2(6)

Table B45 – Laboratory 60

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{3}H	55(4) × 10^{1}	491(5)	1.75	2.54	12(7)
^{35}S	385(25)	411.1(11)	-1.04	-0.95	-6(6)
	(Bq g^{-1})	(Bq g^{-1})			
^{55}Fe	6.5(5)	6.89(12)	-0.76	-0.73	-6(8)
^{89}Sr	13.6(14)	12.83(20)	0.56	0.63	6(11)
^{90}Sr	10.2(8)	10.189(16)	0.01	0.02	0(8)
^{238}U	0.99(4)	1.059(24)	-1.49	-1.45	-7(5)
^{238}Pu	2.53(8)	2.607(9)	-1.01	-0.56	-3(3)
^{239}Pu	5.89(18)	6.06(3)	-0.95	-0.52	-3(3)
^{241}Am	3.55(14)	3.691(13)	-0.99	-0.75	-4(4)
^{22}Na	2.34(8)	2.498(9)	-1.97	-1.69	-6(4)
^{60}Co	5.26(15)	5.094(16)	1.10	0.89	3(3)
^{88}Y	1.22(4)	1.204(5)	0.39	0.31	1(4)
^{95}Zr	1.22(6)	1.176(12)	0.73	0.79	4(5)
^{95}Nb	2.4(6) Q	2.456(25)	-0.03	-0.13	-1(25)
^{125}Sb	5.40(20)	5.39(4)	0.06	0.05	0(4)
^{133}Ba	4.66(23)	4.79(4)	-0.56	-0.58	-3(5)
^{134}Cs	2.71(11)	2.736(19)	-0.23	-0.23	-1(4)
^{137}Cs	2.70(8)	2.632(18)	0.83	0.68	3(3)
^{152}Eu	2.42(9)	2.380(16)	0.43	0.38	2(4)

Table B46 – Laboratory 61

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{22}Na	3.84(14)	3.718(14)	0.87	0.38	3(4)
^{60}Co	21.0(7)	18.84(6)	3.36 Q	2.57	11(4)
^{88}Y	4.56(20)	3.843(14)	3.58 Q	2.52	19(5)
^{95}Zr	2.38(24)	1.836(19)	2.26	2.13	30(13)
^{95}Nb	9.0(4)	3.84(4)	12.85 D	10.64 D	135(11)
^{125}Sb	7.0(3)	6.48(4)	1.91	1.15	9(5)
^{133}Ba	6.46(24)	5.74(4)	2.95 Q	1.91	12(5)
^{134}Cs	4.58(15)	5.30(4)	-4.66 Q	-2.35	-14(3)
^{137}Cs	2.94(10)	2.884(20)	0.55	0.28	2(4)
^{152}Eu	2.78(13)	4.19(3)	-10.59 D	-4.12 D	-34(3)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.31(7)	2.498(9)	-2.67 Q	-2.01	-8(3)
^{60}Co	5.30(18)	5.094(16)	1.14	1.11	4(4)
^{88}Y	1.34(6)	1.204(5)	2.25	2.72 Q	11(5)
^{95}Zr	1.55(9)	1.176(12)	4.12 D	6.69 D	32(8)
^{95}Nb	5.07(17)	2.456(25)	15.21 D	21.34 D	106(7)
^{125}Sb	5.68(23)	5.39(4)	1.25	1.32	5(5)
^{133}Ba	4.90(15)	4.79(4)	0.71	0.49	2(4)
^{134}Cs	2.03(8)	2.736(19)	-8.58 D	-6.35 D	-26(3)
^{137}Cs	2.30(7)	2.632(18)	-4.60 D	-3.33 D	-13(3)
^{152}Eu	2.10(8)	2.380(16)	-3.43 D	-2.69 D	-12(4)

Table B47 – Laboratory 62

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
^{90}Sr	6.2(7)	8.900(19)	-3.86 D	-3.77 D	-30(8)
^{238}Pu	10.5(10)	15.28(5)	-4.55 D	-6.26 D	-31(7)
^{239}Pu	8.1(4)	13.29(6)	-12.60 D	-8.57 D	-39(3)
^{241}Am	9.6(4)	11.99(4)	-5.80 D	-3.98 D	-20(4)
^{22}Na	3.3(5)	3.718(14)	-0.91	-1.29	-11(12)
^{57}Co	1.30(20)	–	–	–	–
^{60}Co	18.1(21)	18.84(6)	-0.35	-0.85	-4(11)
^{88}Y	3.3(5)	3.843(14)	-1.13	-1.91	-14(12)
^{95}Zr	1.5(6)	1.836(19)	-0.70	-1.47	-2(3) × 10^{1}
^{95}Nb	6.6(10)	3.84(4)	2.70 D	5.61 D	7(3) × 10^{1}
^{125}Sb	6.9(9)	6.48(4)	0.47	0.90	7(15)
^{133}Ba	4.8(6)	5.74(4)	-1.54	-2.43	-16(10)
^{134}Cs	4.7(6)	5.30(4)	-1.15	-2.09	-12(11)
^{137}Cs	3.2(5)	2.884(20)	0.79	1.70	12(15)
^{3}H	496(17)	491(5)	0.26	0.20	1(4)

Table B48 – Laboratory 63

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.40(9)	2.498(9)	-1.09	-1.05	-4(4)
^{60}Co	5.47(20)	5.094(16)	1.88	2.02	7(4)
^{88}Y	1.26(5)	1.204(5)	1.11	1.12	5(4)
^{95}Zr	1.24(5)	1.176(12)	1.25	1.15	5(5)
^{95}Nb	4.01(9)	2.456(25)	16.64 D	12.69 D	63(4)
^{125}Sb	5.62(21)	5.39(4)	1.09	1.05	4(4)
^{133}Ba	4.88(18)	4.79(4)	0.49	0.41	2(4)
^{134}Cs	2.54(9)	2.736(19)	-2.13	-1.76	-7(4)
^{137}Cs	2.81(6)	2.632(18)	2.84 Q	1.78	6.8(24)
^{152}Eu	2.44(9)	2.380(16)	0.65	0.57	3(4)

Table B49 – Laboratory 64

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
^{22}Na	2.43(18)	2.498(9)	-0.38	-0.73	-3(7)
^{60}Co	5.1(3)	5.094(16)	-0.07	-0.13	0(7)
^{88}Y	1.22(9)	1.204(5)	0.17	0.31	1(8)
^{95}Zr	1.23(11)	1.176(12)	0.49	0.97	5(9)
^{95}Nb	4.9(4)	2.456(25)	6.17 D	20.20 D	101(16)
^{125}Sb	5.5(4)	5.39(4)	0.22	0.37	2(7)
^{133}Ba	5.0(4)	4.79(4)	0.40	0.76	4(9)
^{134}Cs	2.81(19)	2.736(19)	0.39	0.67	3(7)
^{137}Cs	2.79(22)	2.632(18)	0.71	1.58	6(8)
^{152}Eu	2.47(17)	2.380(16)	0.53	0.86	4(7)

Appendix C. Source preparation

C1 ABL samples

A mixed radionuclide solution (B05240) was prepared by mixing standardised solutions of the individual nuclides (Table C1). The chemical form of ABL was 1.9 M HNO_3 (containing 0.010 mg g^{-1} Fe, 0.010 mg g^{-1} Sr and 0.010 mg g^{-1} Y). The ^{241}Am dilution was validated using gamma-ray spectrometry.

Table C1 – Starting material B05240

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Dilution factor ABL GDF1	B05240 Act. conc. (kBq g^{-1})
^{55}Fe	A05006	65.8(11)	65.636(18)	1.003(17)
^{85}Sr*	A409/04	0.172(4)	69.77(5)	0.00247(6)
^{89}Sr	A409/04	78.9(13)	69.77(5)	1.132(18)
^{90}Sr	A626/03	40.39(6)	71.59(10)	0.5643(9)
^{238}U	A272/00 and A274/00	0.1015(23)	1.28890(6)	0.0787(18)
^{238}Pu	A05212	17.67(6)	18.239(6)	0.969(3)
^{239}Pu	A628/03	19.89(9)	23.602(7)	0.843(4)
^{240}Pu*	A628/03	0.087	23.602(7)	0.0037
^{241}Pu*	A628/03	0.13	23.602(7)	0.0053
^{241}Am	A05320	9.10(3)	11.9678(9)	0.760(3)

The B05240 solution was diluted three times to produce the ABL sample in B05339 (Table C2). All dilutions were validated using Cherenkov counting. In total, 15.429 kg of ABL sample was produced.

Table C2 – Preparation of solution for ABL source B05339

Nuclide	Dilution factor ABL GDF2	Dilution factor ABL GDF3	Dilution factor ABL GDF4	B05339 Act. conc. (Bq kg^{-1})
^{55}Fe	39.585(6)	40.107(20)	39.934(9)	15.8(3)
^{85}Sr*	39.585(6)	40.107(20)	39.934(9)	0.0389(9)
^{89}Sr	39.585(6)	40.107(20)	39.934(9)	17.8(3)
^{90}Sr	39.585(6)	40.107(20)	39.934(9)	8.900(19)
^{238}U	39.585(6)	40.107(20)	39.934(9)	1.24(3)
^{238}Pu	39.585(6)	40.107(20)	39.934(9)	15.28(5)
^{239}Pu	39.585(6)	40.107(20)	39.934(9)	13.29(6)
^{240}Pu*	39.585(6)	40.107(20)	39.934(9)	0.058
^{241}Pu*	39.585(6)	40.107(20)	39.934(9)	0.084
^{241}Am	39.585(6)	40.107(20)	39.934(9)	11.99(4)

C2 ABH samples

A mixed radionuclide solution (B05241) was prepared by mixing standardised solutions of the individual nuclides (Table C3). The chemical form of ABH was 1.9 M HNO_3 (containing 0.010 mg g^{-1} Fe, 0.010 mg g^{-1} Sr and 0.010 mg g^{-1} Y). The ^{241}Am dilution was validated using gamma-ray spectrometry.

Table C3 – Starting material B05241

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Dilution factor ABH GDF1	B05241 Act. conc. (kBq g^{-1})
^{55}Fe	A05006	65.8(11)	112.83(3)	0.584(10)
^{85}Sr*	A409/04	0.172(4)	72.66(10)	0.00237(6)
^{89}Sr	A409/04	78.9(13)	72.66(10)	1.087(17)
^{90}Sr	A626/03	40.39(6)	46.80(5)	0.8630(13)
^{238}U	A272/00 and A274/00	0.1015(23)	1.13162(12)	0.0897(20)
^{238}Pu	A05212	17.67(6)	80.00(12)	0.2208(8)
^{239}Pu	A628/03	19.89(9)	38.73(3)	0.5134(22)
^{240}Pu*	A628/03	0.087	38.73(3)	0.0023
^{241}Pu*	A628/03	0.13	38.73(3)	0.0033
^{241}Am	A05320	9.10(3)	29.096(20)	0.3126(11)

The B05241 solution was diluted once to produce the ABH sample in B05254 (Table C4). The dilution was validated using Cherenkov counting. In total, 0.703 kg of ABH sample was produced.

Table C4 – Preparation of solution for ABH source B05254

Nuclide	Dilution factor ABH GDF2	B05254 Act. conc. (Bq g^{-1})
^{55}Fe	84.71(4)	6.89(12)
^{85}Sr*	84.71(4)	0.0280(7)
^{89}Sr	84.71(4)	12.83(20)
^{90}Sr	84.71(4)	10.189(16)
^{238}U	84.71(4)	1.059(24)
^{238}Pu	84.71(4)	2.607(9)
^{239}Pu	84.71(4)	6.06(3)
^{240}Pu*	84.71(4)	0.027
^{241}Pu*	84.71(4)	0.038
^{241}Am	84.71(4)	3.691(13)

C3 GL samples

A mixed radionuclide solution (B05113) was prepared by mixing and diluting standardised solutions of the individual nuclides (Table C5). The chemical form of GL was 2.1 M HCl and 0.1 M oxalic acid containing 0.049 mg g^{-1} Ba, 0.049 mg g^{-1} Co, 0.050 mg g^{-1} Na, 0.050 mg g^{-1} Nb, 0.049 mg g^{-1} Sb, 0.049 mg g^{-1} Y and 0.046 mg g^{-1} Zr. The dilutions were validated using gamma-ray spectrometry.

Table C5 – Starting material B05113

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Dilution factor GL GDF1	B05113 Act. conc. (kBq g^{-1})
^{22}Na	A479/02	9.85(4)	19.173(3)	0.5137(19)
^{60}Co	A05329	239.0(7)	91.81(7)	2.603(8)
^{88}Y	A05328	16.38(6)	30.840(5)	0.5310(19)
^{95}Zr	A569/04, A570/04 and A584/04	4.75(5)	18.7241(17)	0.254(3)
^{95}Nb	A569/04, A570/04 and A584/04	9.92(10)	18.7241(17)	0.530(6)
^{125}Sb	A590/04	14.23(9)	15.892(7)	0.895(6)
^{133}Ba	A477/04	17.76(12)	22.382(5)	0.793(6)
^{134}Cs	A15/04	17.56(12)	23.962(3)	0.733(5)
^{137}Cs	A16/04	18.71(13)	46.959(8)	0.399(3)
^{152}Eu	A516/04	26.95(19)	46.518(9)	0.579(4)
^{154}Eu*	A516/04	0.081(13)	46.518(9)	0.0017(3)

The solution in B05113 were diluted three times to produce the GL sample in B05116 (Table C6). All dilutions were validated using gamma-ray spectrometry. In total, 25.103 kg of GL sample was produced.

Table C6 – Preparation of solution for GL source B05116

Nuclide	Dilution factor GL GDF2	Dilution factor GL GDF3	Dilution factor GL GDF4	B05116 Act. conc.	Measured Act. conc. (Bq kg^{-1})
^{22}Na	51.361(6)	51.69(3)	52.050(18)	3.718(14)	*3.59(11)*
^{60}Co	51.361(6)	51.69(3)	52.050(18)	18.84(6)	*18.3(3)*
^{88}Y	51.361(6)	51.69(3)	52.050(18)	3.843(14)	*3.95(25)*
^{95}Zr	51.361(6)	51.69(3)	52.050(18)	1.836(19)	*1.5(5)*
^{95}Nb	51.361(6)	51.69(3)	52.050(18)	3.84(4)	*3.2(10)*
^{125}Sb	51.361(6)	51.69(3)	52.050(18)	6.48(4)	*6.56(12)*
^{133}Ba	51.361(6)	51.69(3)	52.050(18)	5.74(4)	*5.53(16)*
^{134}Cs	51.361(6)	51.69(3)	52.050(18)	5.30(4)	*5.20(14)*
^{137}Cs	51.361(6)	51.69(3)	52.050(18)	2.884(20)	*2.93(9)*
^{152}Eu	51.361(6)	51.69(3)	52.050(18)	4.19(3)	*4.15(11)*
^{154}Eu*	51.361(6)	51.69(3)	52.050(18)	0.0127(20)	–

C4 GH samples

A mixed radionuclide solution (B05114) was prepared by mixing and diluting standardised solutions of the individual nuclides (Table C7). The chemical form of GH was 2.1 M HCl and 0.1 M oxalic acid containing 0.049 mg g^{-1} Ba, 0.049 mg g^{-1} Co, 0.050 mg g^{-1} Na, 0.050 mg g^{-1} Nb, 0.049 mg g^{-1} Sb, 0.049 mg g^{-1} Y and 0.046 mg g^{-1} Zr. The dilutions were validated using gamma-ray spectrometry.

Table C7 – Starting material B05114

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Dilution factor GDF1	B05114 Act. conc. (kBq g^{-1})
^{22}Na	A479/02	9.85(4)	7.4550(6)	1.321(5)
^{60}Co	A05329	239.0(7)	88.729(15)	2.693(8)
^{88}Y	A05328	16.38(6)	25.7154(12)	0.6369(22)
^{95}Zr	A569/04, A570/04 and A584/04	4.75(5)	7.6407(3)	0.622(6)
^{95}Nb	A569/04, A570/04 and A584/04	9.92(10)	7.6407(3)	1.299(13)
^{125}Sb	A590/04	14.23(9)	4.99466(9)	2.849(17)
^{133}Ba	A477/04	17.76(12)	7.0119(4)	2.533(17)
^{134}Cs	A15/04	17.56(12)	12.1380(5)	1.447(10)
^{137}Cs	A16/04	18.71(13)	13.4452(5)	1.392(10)
^{152}Eu	A516/04	26.95(19)	21.412(4)	1.259(9)
^{154}Eu*	A516/04	0.081(13)	21.412(4)	0.0038(6)

The solution in B05114 were diluted twice to produce the GH sample in B05123 (Table C8). The dilutions were validated using gamma-ray spectrometry. In total, 5.046 kg of GH sample was produced.

Table C8 – Preparation of solution for GH source B05123

Nuclide	Dilution factor GH GDF2	Dilution factor GH GDF3	B05123 Act. conc. (Bq g^{-1})	Measured Act. conc. (Bq g^{-1})
^{22}Na	23.928(11)	22.099(7)	2.498(9)	*2.557(25)*
^{60}Co	23.928(11)	22.099(7)	5.094(16)	*5.04(7)*
^{88}Y	23.928(11)	22.099(7)	1.204(5)	*1.189(18)*
^{95}Zr	23.928(11)	22.099(7)	1.176(12)	*1.22(3)*
^{95}Nb	23.928(11)	22.099(7)	2.456(25)	*2.55(8)*
^{125}Sb	23.928(11)	22.099(7)	5.39(4)	*5.45(11)*
^{133}Ba	23.928(11)	22.099(7)	4.79(4)	*4.60(8)*
^{134}Cs	23.928(11)	22.099(7)	2.736(19)	*2.79(5)*
^{137}Cs	23.928(11)	22.099(7)	2.632(18)	*2.60(4)*
^{152}Eu	23.928(11)	22.099(7)	2.380(16)	*2.27(3)*
^{154}Eu*	23.928(11)	22.099(7)	0.0072(11)	–

C5 LB samples

A mixed radionuclide solution (B05393) was prepared by mixing standardised solutions of the individual nuclides (Table C9). The chemical form of LB was 0.001 M NaOH containing 0.051 mg g^{-1} C as carbonate and 0.050 mg g^{-1} S as sulphate.

Table C9 – Starting material B05393

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Dilution factor GDF1	B05393 Act. conc. (kBq g^{-1})
^{3}H	A05308	13.99(14)	44.81(5)	0.312(3)
^{14}C	E3002/3/4	0.1059(7)	1.04048(7)	0.1018(7)
^{35}S	J05077	26.03(6)	99.79(11)	0.2608(7)

The solution in B05393 were diluted twice to produce the LB sample in B05401 (Table C10). The dilutions were validated using liquid scintillation counting. In total, 17.359 kg of LB sample was produced.

Table C10 – Preparation of solution for LB source B05401

Nuclide	Dilution factor LB GDF2	Dilution factor LB GDF3	B05401 Act. conc. (Bq kg^{-1})
^{3}H	25.031(9)	25.389(5)	491(5)
^{14}C	25.001(9)	25.377(4)	160.4(10)
^{35}S	25.001(9)	25.377(4)	411.1(10)

Appendix D. Dilution checks

Table D1 – Dilution checks ABL and ABH samples

	ABL	ABH
GDF1 vs. RDF1 ^{241}Am	11.9678(9) vs. 12.04(16)	29.096(20) vs.29.4(4)
zeta score DF1 ^{241}Am	**0.43**	**0.69**
GDF2 vs.RDF2	39.585(6) vs. 39.63(9)	84.71(4) vs. 84.8(3)
zeta score DF2	**0.42**	**0.35**
GDF3 vs. RDF3	40.107(20) vs.40.4(4)	–
zeta score DF3	**0.86**	–
GDF4 vs. RDF4	39.934(9) vs. 39.2(10)	–
zeta score ABL DF4	**0.73**	–

Table D2 – Dilution checks GL and GH samples

	GL	GH
GDF1 vs. RDF1 ^{22}Na	19.173(3) vs. 19.21(16)	7.4550(6) vs. 7.50(6)
zeta score DF1 ^{22}Na	**0.23**	**0.75**
GDF1 vs. RDF1 ^{60}Co	91.81(7) vs. 92.3(10)	88.729(15) vs. 88.9(9)
zeta score DF1 ^{60}Co	**0.49**	**0.19**
GDF1 vs. RDF1 ^{88}Y	30.840(5) 30.80(25)	25.7154(12) vs. 25.69(19)
zeta score DF1 ^{88}Y	**0.15**	**0.15**
GDF1 vs. RDF1 ^{95}Zr	18.7241(17) vs. 18.9(3)	7.6407(3) vs. 7.68(11)
zeta score DF1 ^{95}Zr	**0.68**	**0.38**
GDF1 vs. RDF1 ^{95}Nb	18.7241(17) vs. 19.4(3)	7.6407(3) vs. 7.79(11)
zeta score DF1 ^{95}Nb	**2.28**	**1.37**
GDF1 vs. RDF1 ^{125}Sb	15.892(7) vs. 16.38(24)	4.99466(9) vs. 5.14(8)
zeta score DF1 ^{125}Sb	**2.00**	**1.83**
GDF1 vs. RDF1 ^{133}Ba	22.382(5) vs. 22.8(4)	7.0119(4) vs. 7.13(13)
zeta score DF1 ^{133}Ba	**0.93**	**0.92**

	GL	GH
GDF1 vs. RDF1 ^{134}Cs	23.962(3) vs. 24.5(4)	12.1380(5) vs. 12.45(17)
zeta score DF1 ^{134}Cs	**1.75**	**1.84**
GDF1 vs. RDF1 ^{137}Cs	46.959(8) vs. 46.9(7)	13.4452(5) vs. 13.51(17)
zeta score DF1 ^{137}Cs	**0.05**	**0.41**
GDF1 vs. RDF1 ^{152}Eu	46.518(9) vs. 46.7(10)	21.412(4) vs. 21.7(4)
zeta score DF1 ^{152}Eu	**0.14**	**0.66**
GDF2 vs. RDF2	51.361(6) 51.48(12)	23.928(11) 24.02(7)
zeta score DF2	**0.96**	**1.37**
GDF3 vs. RDF3	51.69(3) vs. 52.1(7)	22.099(7) vs. 22.27(9)
zeta score DF3	**0.64**	**1.89**
GDF4 vs. RDF4	52.050(18) vs. 49.1(18) to 53.4(8)	–
zeta scores DF4	**< 1.73**	**–**

Table D3 – Dilution checks LB samples

	^{3}H	^{14}C and ^{35}S
LB GDF2	25.031(9)	–
LB GDF2	–	25.001(9)
LB RDF2	25.10(11)	25.10(11)
zeta score LB DF2	**0.58**	**0.84**
LB GDF3	25.389(5)	–
LB GDF3	–	25.377(4)
LB RDF3	25.46(22)	25.46(22)
zeta score LB DF3	**0.33**	**0.38**

Appendix E. Sample details

Lab code	ABL	ABH	GL	GH	LB	Date results received
4	x	x	x	x	x	15 December 2005
5			x	x	x	19 December 2005
7	x	x	x	x		16 December 2005
8	x	x	x	x	x	23 January 2006
9				x	x	16 December 2005
10			x	x		16 December 2005
13	x		x	x	x	14 December 2005
14		x		x		16 December 2005
15			x	x		16 December 2005
17	x	x	x	x	x	16 December 2005
18			x	x		16 December 2005
19	x		x		x	15 December 2005
21	x	x	x	x	x	12 December 2005
22	x	x			x	13 December 2005
23			x			1 December 2005
24			x	x		14 December 2005
25	x			x	x	16 December 2005
26	x			x		2 February 2006
27			x	x		16 December 2005
28	x	x	x	x	x	16 December 2005
29	x		x		x	18 November 2005
32		x	x		x	16 December 2005
34	x		x		x	19 December 2005
35	x		x	x	x	23 December 2005
36		x		x	x	16 December 2005
38		x		x	x	15 December 2005
40	x		x		x	15 December 2005
41	x		x		x	15 December 2005
42	x		x			16 December 2005
45			x			15 November 2005
46			x	x	x	15 December 2005
47	x	x	x	x		30 November 2005
48				x	x	21 December 2005
49		x		x	x	16 December 2005
50				x		15 December 2005
51			x			3 February 2006
52			x	x		22 November 2005
53			x	x		22 November 2005
54			x	x		16 December 2005
55		x		x	x	15 December 2005
56	x		x		x	18 December 2005
57				x		19 December 2005
58			x			16 December 2005
59		x		x		19 December 2005
60		x		x	x	27 January 2006
61			x	x		20 December 2005
62	x		x		x	16 December 2005
63				x		15 December 2005
Total	**20**	**16**	**34**	**34**	**26**	

Appendix F. Dixon's Q outlier tests

Table F1 – Dixon's Q outlier parameters for a level of confidence of 98% (α = 0.02)

N	Q_{10}	Q_{11}	Q_{12}	Q_{20}	Q_{21}	Q_{22}
4	0.889	0.991	–	0.992	–	–
5	0.780	0.916	0.992	0.929	0.995	–
6	0.698	0.805	0.925	0.836	0.951	0.995
7	0.637	0.740	0.836	0.778	0.885	0.945
8	0.590	0.683	0.760	0.710	0.829	0.890
9	0.555	0.635	0.702	0.667	0.776	0.840
10	0.527	0.597	0.655	0.632	0.726	0.791
11	0.502	0.566	0.619	0.603	0.679	0.745
12	0.482	0.541	0.590	0.579	0.642	0.704
13	0.465	0.520	0.564	0.557	0.615	0.670
14	0.450	0.502	0.542	0.538	0.593	0.641
15	0.438	0.486	0.523	0.522	0.574	0.616
16	0.426	0.472	0.508	0.508	0.557	0.595
17	0.416	0.460	0.493	0.495	0.542	0.577
18	0.407	0.449	0.480	0.484	0.529	0.561
19	0.398	0.439	0.469	0.473	0.517	0.547
20	0.391	0.430	0.458	0.464	0.506	0.535
21	0.384	0.421	0.449	0.455	0.496	0.524
22	0.378	0.414	0.440	0.447	0.487	0.514
23	0.372	0.407	0.432	0.440	0.479	0.505
24	0.367	0.400	0.423	0.434	0.471	0.497
25	0.362	0.394	0.417	0.428	0.464	0.489
26	0.357	0.389	0.411	0.422	0.457	0.482
27	0.353	0.383	0.405	0.417	0.450	0.475
28	0.349	0.378	0.399	0.412	0.444	0.469
29	0.345	0.374	0.394	0.407	0.438	0.463
30	0.341	0.369	0.389	0.402	0.433	0.457

Table F2 – Dixon's Q outlier parameters for a level of confidence of 99% (α = 0.01)

N	Q_{10}	Q_{11}	Q_{12}	Q_{20}	Q_{21}	Q_{22}
4	0.926	0.995	–	0.996	–	–
5	0.821	0.937	0.996	0.950	0.998	–
6	0.740	0.839	0.951	0.865	0.970	0.998
7	0.680	0.782	0.875	0.814	0.919	0.970
8	0.634	0.725	0.797	0.746	0.868	0.922
9	0.598	0.677	0.739	0.700	0.816	0.873
10	0.568	0.639	0.694	0.664	0.760	0.826
11	0.542	0.606	0.658	0.627	0.713	0.781
12	0.522	0.580	0.629	0.612	0.675	0.740
13	0.503	0.558	0.602	0.590	0.649	0.705
14	0.488	0.539	0.580	0.571	0.627	0.674
15	0.475	0.522	0.560	0.554	0.607	0.647
16	0.463	0.508	0.544	0.539	0.580	0.624
17	0.452	0.495	0.529	0.526	0.573	0.605
18	0.442	0.484	0.516	0.514	0.559	0.589
19	0.433	0.473	0.504	0.503	0.547	0.575
20	0.425	0.464	0.493	0.494	0.536	0.562
21	0.418	0.455	0.483	0.485	0.526	0.551
22	0.411	0.446	0.474	0.477	0.517	0.541
23	0.404	0.439	0.465	0.469	0.509	0.532
24	0.399	0.432	0.457	0.462	0.501	0.524
25	0.393	0.426	0.450	0.456	0.493	0.516
26	0.388	0.420	0.443	0.450	0.486	0.508
27	0.384	0.414	0.437	0.444	0.479	0.501
28	0.380	0.409	0.431	0.439	0.472	0.495
29	0.376	0.404	0.426	0.434	0.466	0.489
30	0.372	0.399	0.420	0.428	0.460	0.483

If Q_{exp} > tabulated Q, then the outlier may be rejected.

Q_{10}: one doubtful result

$$Q_{exp} = \frac{x_n - x_{n-1}}{x_n - x_1}$$

Q_{11}: two doubtful results on opposite ends and one is being tested

$$Q_{exp} = \frac{x_n - x_{n-1}}{x_n - x_2}$$

Q_{12}: three doubtful results distributed unevenly and the lone one is tested

$$Q_{exp} = \frac{x_n - x_{n-1}}{x_n - x_3}$$

Q_{20}: two doubtful results both located at one side

$$Q_{exp} = \frac{x_n - x_{n-2}}{x_n - x_1}$$

Q_{21}: three doubtful results distributed unevenly; the furthest of the pair is tested

$$Q_{exp} = \frac{x_n - x_{n-2}}{x_n - x_2}$$

Q_{22}: four doubtful results distributed evenly on either side and one is tested

$$Q_{exp} = \frac{x_n - x_{n-2}}{x_n - x_3}$$

Adapted from D.B. Rorabacher, *Anal. Chem.,* **1991**, 63, 139.

Table F3 – Relative uncertainty ratio outliers

Nuclide	Laboratory	Dixon test	Result	Tabulated value
^{55}Fe ABL	7	Q_{10}	0.900	0.889
^{90}Sr ABL	22E	Q_{20}	0.581	0.557
^{238}U ABL	28	Q_{10}	0.694	0.438
^{90}Sr ABH	22E	Q_{10}	0.511	0.465
^{22}Na GL	27	Q_{20}	0.485	0.402
^{95}Zr GL	15	Q_{10}	0.546	0.353
^{22}Na GH	26	Q_{20}	0.541	0.402
^{22}Na GH	27	Q_{10}	0.452	0.341
^{60}Co GH	27	Q_{10}	0.516	0.341
^{88}Y GH	27	Q_{10}	0.560	0.341
^{95}Zr GH	27	Q_{20}	0.611	0.402
^{95}Zr GH	4	Q_{10}	0.548	0.341
^{95}Nb GH	27	Q_{20}	0.719	0.402
^{95}Nb GH	60	Q_{10}	0.585	0.341
^{125}Sb GH	27	Q_{10}	0.475	0.341
^{133}Ba GH	27	Q_{10}	0.472	0.341
^{134}Cs GH	27	Q_{10}	0.500	0.341
^{137}Cs GH	27	Q_{10}	0.508	0.341
^{152}Eu GH	27	Q_{10}	0.418	0.341
^{3}H LB	17	Q_{20}	0.428	0.412
^{14}C LB	48	Q_{10}	0.633	0.502

Table F4 – Deviation outliers

Nuclide	Laboratory	Dixon test	Result	Tabulated value
^{239}Pu ABL	62	Q_{20}	0.624	0.526
^{239}Pu ABL	19	Q_{10}	0.596	0.463
^{239}Pu ABL	28	Q_{20}	0.593	0.554
^{241}Am ABL	26	Q_{10}	0.811	0.475
^{241}Am ABL	62	Q_{10}	0.561	0.488
^{90}Sr ABH	7	Q_{10}	0.599	0.503
^{238}Pu ABH	21	Q_{10}	0.843	0.488
^{238}Pu ABH	49	Q_{11}	0.658	0.558
^{241}Am ABH	14	Q_{10}	0.537	0.463
^{22}Na GL	23	Q_{20}	0.500	0.428
^{60}Co GL	23	Q_{20}	0.442	0.428
^{95}Zr GL	5	Q_{10}	0.464	0.384
^{22}Na GH	25	Q_{10}	0.493	0.372
^{95}Zr GH	48	Q_{22}	0.567	0.483
^{95}Zr GH	57	Q_{21}	0.494	0.460
^{95}Zr GH	7	Q_{11}	0.409	0.399
^{95}Zr GH	61	Q_{10}	0.527	0.372
^{133}Ba GH	27	Q_{11}	0.443	0.399
^{134}Cs GH	26	Q_{11}	0.422	0.399
^{137}Cs GH	27	Q_{10}	0.378	0.372

Appendix G. Nuclear data

Table G1 – Half-lives

Nuclide	Half-life (d)	Reference
^{3}H	4500(7)	DDEP
^{14}C	$2.082(11) \times 10^{6}$	DDEP
^{22}Na	950.6(4)	DDEP
^{35}S	87.32(16)	DDEP
^{55}Fe	1001.1(22)	DDEP
^{60}Co	1925.2(4)	DDEP
^{88}Y	106.626(21)	DDEP
^{89}Sr	50.57(3)	DDEP
^{90}Sr	10551(14)	MPH
^{95}Zr	64.032(6)	DDEP
^{95}Nb	34.991(6)	DDEP
^{125}Sb	1007.54(9)	DDEP
^{133}Ba	3849.7(22)	DDEP
^{134}Cs	753.5(10)	WCW
^{137}Cs	10981(11)	MPH
^{152}Eu	4939(6)	DDEP
^{238}U	$1.6319(11) \times 10^{12}$	NuDat
^{238}Pu	32046(11)	DDEP
^{239}Pu	$8.806(11) \times 10^{6}$	NuDat
^{241}Am	$1.5800(22) \times 10^{5}$	DDEP

DDEP – Decay Data Evaluation Project (DDEP): www.nucleide.org/DDEP_WG/DDEPdata.htm
MPH – MacMahon, D., Pearce, A., Harris, P., (2004). Appl. Rad. Isot. 60 275-281
WCW – Woods, M., Collins, S., Woods, S., (2004). NPL Report CAIR 8
NuDat – NuDat - ENSDF data: www.nndc.bnl.gov/nudat2/

Appendix H. Acknowledgements

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Appendix I. Literature

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