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Report

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ENVIRONMENTAL RADIOACTIVITY PROFICIENCY TEST EXERCISE 2007

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Environmental Radioactivity Proficiency Test Exercise 2007

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ABSTRACT

The results of NPL's thirteenth Environmental Radioactivity Proficiency Test Exercise are reported. This exercise included preparing more than 200 samples and distributing them to 32 participants in the UK and 33 overseas participants. Eight different sample types were offered: an aqueous mixture of seven alpha emitters at two concentration levels, an aqueous mixture of six beta emitters at two concentration levels, an aqueous mixture of ten gamma emitters at two concentration levels, an aqueous mixture of four beta emitters and a solid neutron-activated concrete powder sample containing a variety of activation products. The level of performance was similar to that observed in the previous Exercise (2005); 73% of the results returned were in good agreement.

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1. INTRODUCTION

This environmental radioactivity proficiency test exercise was the thirteenth 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 2007 exercise, eight samples types were available for analysis:

(i) **AL**; a 'low-level' mixture of α-emitting radionuclides in 500 g of dilute nitric acid (1 – 20 Bq kg^{-1} per radionuclide)
(ii) **AH**; a 'high-level' mixture of α-emitting radionuclides in 20 g of dilute nitric acid (1 – 20 Bq g^{-1} per radionuclide)
(iii) **BL**; a 'low-level' mixture of β-emitting radionuclides in 500 g of dilute hydrochloric acid (1 – 20 Bq kg^{-1} per radionuclide)
(iv) **BH**; a 'high-level' mixture of β-emitting radionuclides in 100 g of dilute hydrochloric acid (1 – 20 Bq g^{-1} per radionuclide)
(v) **B2**; a mixture of β-emitting radionuclides in 500 g of HEPES buffer solution at pH 8.0 (100 – 500 Bq kg^{-1} per radionuclide)
(vi) **GL**; a 'low-level' mixture of γ-emitting radionuclides in 500 g of dilute hydrochloric acid (1 – 20 Bq kg^{-1} per radionuclide)
(vii) **GH**; a 'high-level' mixture of γ-emitting radionuclides in 100 g of dilute hydrochloric acid (1 – 20 Bq g^{-1} per radionuclide)
(viii) **C**; neutron activated crushed concrete containing a variety of radionuclides (up to ~1 Bq g^{-1} per radionuclide except for the tritium component)

This report describes how the exercise was carried out. As in previous years, the principal objective was to assess the performance of the participating laboratories. This required the participants to identify and/or traceably quantify the activity levels of radionuclides present in the samples, whereas the tasks of NPL were to prepare and distribute the samples to the participating laboratories, to collect, analyse and interpret the results and to compile a comprehensive report.

The assigned activity concentration values of all the radionuclides were traceable to national standards of radioactivity, except for the nuclides in the C sample in which case the consensus value of the returned results was taken as the assigned value. The 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 was expected to demonstrate each participant's ability (i) to identify and quantify the activity levels of the radionuclides present in the GL and/or GH sources without prior knowledge of the radionuclide content, (ii) quantify the activity levels of the radionuclides present in the AL, AH, BL, BH, B2 and/or C sources with prior knowledge of the radionuclide content, (iii) to complete the measurement in a timely manner and (iv) to provide a full uncertainty budget for each measurement.

As in previous exercises, a list of the radionuclides present in the AL and AH sources (both containing a mixture of ^{226}Ra, ^{237}Np, ^{238}U, ^{238}Pu, ^{239}Pu, ^{241}Am and ^{244}Cm), the BL and BH sources (both containing a mixture of ^{3}H, ^{55}Fe, ^{63}Ni, ^{89}Sr, ^{90}Sr and ^{99}Tc), the B2 sources (containing a mixture of ^{3}H [both tritiated water and

Organically Bound Tritium (OBT)], ^{14}C, ^{36}Cl and ^{129}I) and the C sources (a "real" solid sample containing a variety of nuclides including ^{3}H, ^{14}C, ^{40}K, ^{41}Ca, ^{55}Fe, ^{60}Co, ^{63}Ni, ^{133}Ba, ^{152}Eu and ^{154}Eu) 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 readily enables unambiguous identification of the nuclides present, although the following candidate list of possible gamma-emitters was provided:

^{7}Be, ^{22}Na, ^{40}K, ^{46}Sc, ^{51}Cr, ^{54}Mn, ^{59}Fe, ^{56}Co, ^{57}Co, ^{58}Co, ^{60}Co, ^{65}Zn, ^{85}Sr, ^{88}Y, ^{91}Y, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{106}Ru, ^{109}Cd, ^{110m}Ag, ^{111}Ag, ^{113}Sn, ^{123m}Te, ^{124}Sb, ^{125}Sb, ^{125}I, ^{134}Cs, ^{137}Cs, ^{133}Ba, ^{140}Ba, ^{139}Ce, ^{141}Ce, ^{144}Ce, ^{147}Nd, ^{152}Eu, ^{154}Eu, ^{155}Eu, ^{153}Gd, ^{160}Tb, ^{166m}Ho, ^{170}Tm, ^{192}Ir, ^{203}Hg and ^{207}Bi.

The data treatment was similar compared to the previous 2005 exercise, although a few minor changes were implemented and a separate data treatment for the C samples was added. A result was only classified as 'in agreement' when three tests (the zeta test, the relative uncertainty outlier test and the *z*-test) 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'.

The graphical representation of the data is similar to that used in the 2005 exercise: (i) the colour-coded deviation plots (dark blue points = results in agreement with NPL; yellow points = questionable results; red points = discrepant results); (ii) 'zeta score' plots, (iii) relative uncertainty plots and (iv) 'Kiri plots', whose development had been inspired by 'Naji plots'.

2. MATERIALS AND METHODS

2.1 Participants

A total of 65 participants took part in the exercise (32 from the United Kingdom and 33 from overseas organisations). A full listing is given in Appendix N. The majority of the samples taken were the GL and GH (45 and 39 participants, respectively). Uptake for the AL, AH, BL, BH, B2 and C samples was 23, 17, 21, 18, 22 and 27, respectively (for details see Appendix F).

2.2 Composition of samples

To prepare the AL, AH, BL, BH, B2, GL and GH 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 radionuclide was determined by dividing the initial single-radionuclide activity concentration by the dilution factors as determined from weighing (i.e., the Gravimetric Dilution Factors, or 'GDFs'). Sets of mixed-radionuclide sources were prepared and counted at each dilution stage in order to derive 'Radiometric Dilution Factors' (RDFs) to confirm those derived gravimetrically. The radionuclides included were all derived from existing stocks of radioactive sources at NPL. The radionuclides were standardised as follows:

^{89}Sr, **^{133}Ba**, **^{134}Cs**, **^{137}Cs, ^{144}Ce, ^{152}Eu, ^{155}Eu, ^{226}Ra** and **^{237}Np** – standardised in an ionisation chamber that had been calibrated by solutions previously standardised by coincidence counting techniques.

^{60}Co, ^{239}Pu, ^{238}U, ^{241}Am and **^{244}Cm** – standardised by absolute counting techniques.

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

^{36}Cl, ^{55}Fe, ^{63}Ni, ^{90}Sr, ^{99}Tc and **^{129}I** – standardised by liquid scintillation counting (using the CIEMAT / NIST efficiency tracing method with ^{3}H).

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

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

Each radionuclide was checked for impurities either by alpha spectrometry, gamma-ray spectrometry or by reference to the original calibration certificate. The following impurities were found: ^{125}Sb (in the ^{144}Ce source), ^{154}Eu (in the ^{152}Eu source), ^{240}Pu and ^{241}Pu (in the ^{239}Pu source) and ^{241}Am (in the ^{144}Ce source). Negligible amounts of ^{233}U, ^{234}U, ^{235}U and ^{236}U were present in the ^{238}U source. Negligible amounts of ^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu were present in the ^{238}Pu source. The ^{244}Cm source contained a small amount of daughter ^{240}Pu and negligible amounts of contaminants (^{245}Cm, ^{246}Cm, ^{247}Cm and ^{248}Cm) combined. 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 was 1 April 2007 12:00 GMT. The deadline for the submission of results was 16 June 2007. In some cases, an extension of the deadline was granted (see Appendix F 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 aqueous solution, the geometry being 1 ml in a 2 ml ampoule. Calibration is achieved via ampoules containing single nuclide solutions which either a) have been directly measured 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 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 selected samples taken from batches prepared for the participants. These measurements were 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 frequency of 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, being of the order of 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 determine Radiometric Dilution Factors and thus confirm Gravimetric Dilution Factors (for the GL and GH samples; see Appendix D for more details).

2.4.2 Liquid scintillation counting

A Packard (Packard Instrument Co., Meriden, CT, USA) Tri-Carb model 2700 TR scintillation spectrometer (with range 0-2000 keV), 20-ml low-potassium glass vials and EcoScint A, EcoScint H and Ultima Gold AB liquid scintillation cocktails were used to standardise ^{36}Cl, ^{55}Fe, ^{63}Ni, ^{90}Sr, ^{99}Tc and ^{129}I using the CIEMAT/NIST method. Each vial contained 10 g of liquid scintillation cocktail and 1.0 g of aqueous phase (containing either the ^{36}Cl, ^{55}Fe, ^{63}Ni, ^{90}Sr, ^{99}Tc and ^{129}I 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. All count rates were corrected for background. The computer programmes CN2004 (PTB, Braunschweig, Germany), Matlab and Axum-7 were used to calculate the activities.

The same counter was also used to confirm Gravimetric Dilution Factors for the AL, AH, BL, BH and B2 samples using Cerenkov counting and liquid scintillation counting; (see Appendix D 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 in a manner traceable to national standards every six months. The conversion from current to source activity in Becquerels is nuclide-dependent, 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 AL and AH samples

The nuclides listed below were the principal radionuclides present in the AL and AH samples.

2.5.1.1 Radium-226

This naturally-occurring nuclide decays mainly by emission of alpha particles to the short-lived radionuclide ^{222}Rn and is part of the uranium-radium decay series. It occurs widely in the environment. The ^{226}Ra source was standardised with an ionisation chamber. The ^{226}Ra source contained ^{210}Pb, ^{210}Bi and ^{210}Po (each ingrown to ~30% of the ^{226}Ra activity).

2.5.1.2 Neptunium-237

This nuclide is produced by the decay of short-lived ^{237}U, which is formed by a ^{238}U (n,2n) reaction. It decays mainly by emission of alpha particles to relatively short-lived ^{233}Pa which subsequently undergoes beta minus decay to ^{233}U. The ^{237}Np source was standardised with an ionisation chamber.

2.5.1.3 Uranium-238

This naturally occurring primordial nuclide decays mainly by emission of alpha particles to ^{234}Th. It occurs widely in the environment. The ^{238}U source was standardised by absolute counting techniques. The activities of ^{233}U, ^{234}U, ^{235}U and ^{236}U in the source were less than 0.25% in total.

2.5.1.4 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 ^{238}Pu source was traceable to a national standard of radioactivity. It contained a small amount of contaminants (^{239}Pu, ^{240}Pu, ^{241}Pu and ^{242}Pu; together these amounted to approximately 0.01% of the total activity).

2.5.1.5 Plutonium-239

This nuclide is produced by neutron activation of ^{238}U (after decay of the short-lived radionuclides ^{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 standardised by absolute counting techniques. The source contained small amounts of contaminants (^{240}Pu, ^{241}Pu and ^{241}Am; together these amounted to about 1% of the total activity).

2.5.1.6 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 absolute counting techniques.

2.5.1.7 Curium-244

This nuclide is produced by multiple neutron activation of ^{238}U, ^{239}Pu and ^{243}Am. It decays by emission of alpha particles to ^{240}Pu. It occurs in the environment as a result of weapon tests and discharges from the nuclear industry. The ^{244}Cm source was standardised by absolute counting techniques. The ^{244}Cm source contained small amounts of contaminants (^{240}Pu: 0.18%; ^{245}Cm, ^{246}Cm, ^{247}Cm and ^{248}Cm); together these amounted to <0.002% of the total activity.

2.5.2 BL and BH samples

The nuclides listed below were the principal radionuclides present in the BL and BH samples.

2.5.2.1 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 undergoes beta minus decay (E_{max} = 18.6 keV) to ^{3}He. The chemical form of ^{3}H in the BL and BH samples was tritiated water. The ^{3}H source was traceable to a national standard of radioactivity.

2.5.2.2 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. The ^{55}Fe source was standardised by liquid scintillation counting (CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.2.3 Nickel-63

This nuclide is produced by neutron activation of ^{62}Ni. It undergoes beta minus decay (E_{max} = 67 keV) to ^{63}Cu. Nickel-63 may be present in environmental samples originating from the nuclear industry. The ^{63}Ni source was standardised by liquid scintillation counting (CIEMAT / NIST efficiency tracing with ^{3}H). It contained a small amount of ^{59}Ni (at 1.00(25)% of the ^{63}Ni activity).

2.5.2.4 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 undergoes beta minus decay (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 has 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 (0.12% of the ^{89}Sr activity), which was determined with gamma spectrometry.

2.5.2.5 Strontium-90

This nuclide is produced by neutron induced fission of ^{235}U and ^{239}Pu. It undergoes beta minus decay (E_{max} = 546 keV) to ^{90}Y which subsequently decays in the same way (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 by liquid scintillation counting (using CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.2.6 Technetium-99

This long-lived nuclide is produced by neutron induced fission of ^{235}U and ^{239}Pu. It undergoes beta minus decay (E_{max} = 294 keV) to ^{99}Ru. It occurs widely in the marine environment as a result discharges from the nuclear industry. The ^{99}Tc source was standardised by liquid scintillation counting (using CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.3 GH and GL samples

The nuclides listed below were the principal radionuclides added to the gamma-emitting sample types (GL and GH). The composition of the GL and GH samples was different from that in the last exercise: ^{22}Na and ^{88}Y were omitted, whilst ^{144}Ce and ^{155}Eu were added.

2.5.3.1 Cobalt-60

This nuclide is mainly produced by neutron activation of ^{59}Co. It undergoes beta minus decay to excited levels of ^{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 absolute counting techniques.

2.5.3.2 Zirconium-95

This fission product undergoes beta minus decay 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. Zirconium-95 was standardised with gamma-ray spectrometry.

2.5.3.3 Niobium-95

This radionuclide is the daughter of both ^{95}Zr and ^{95m}Nb and is therefore present in any ^{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 undergoes beta minus decay to excited levels of ^{95}Mo. 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 by gamma-ray spectrometry.

2.5.3.4 Antimony-125

This fission product undergoes beta minus decay to excited levels of ^{125}Te. 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 its decay, some of which are coincident with one another, so 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 by coincidence and anti-coincidence liquid scintillation counting.

2.5.3.5 Barium-133

This nuclide decays by electron capture to excited levels of ^{133}Cs. Barium-133 is present in some types of nuclear waste (e.g., activated concrete), and it is well known as a nuclide which shows coincidence summing effects on high efficiency detectors. Barium-133 was standardised with an ionisation chamber.

2.5.3.6 Caesium-134

This activation product undergoes beta plus decay to excited levels of ^{134}Xe and beta minus decay to excited levels of ^{134}Ba. 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.

2.5.3.7 Caesium-137

This fission product undergoes beta minus decay 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 (i.e., 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.

2.5.3.8 Cerium-144

This fission product undergoes beta minus decay to short-lived ^{144m}Pm and ^{144}Pm which subsequently decay by isomeric transition to ^{144}Pm and beta minus emission to ^{144}Nd (a very long-lived alpha-emitting nuclide), respectively. Cerium-144 was standardised using an ionisation chamber. Americium-241 and ^{125}Sb, which were present as impurities (4.2% and 0.17% of the ^{144}Ce activity, respectively), were determined by gamma-ray spectrometry.

2.5.3.9 Europium-152
This activation product decays via electron capture (72.1%) to excited levels of ^{152}Sm and by beta minus emissions (27.9%) to excited levels of ^{152}Gd. Europium-152 is present in nuclear waste and 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 using gamma-ray spectrometry.

2.5.3.10 Europium-155
This minor fission product undergoes beta minus decay to excited levels and ground state of ^{155}Gd. Europium-155 was standardised with an ionisation chamber.

2.5.4 B2 samples

The nuclides listed below were the principal radionuclides present in the B2 samples. The composition of the B2 sample was different from that used in the last exercise: ^{35}S was omitted while OBT, ^{36}Cl and ^{129}I were added.

2.5.4.1 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 undergoes beta minus decay (E_{max} = 18.6 keV) to ^{3}He. The chemical forms of ^{3}H in the B2 samples were tritiated water and Organically Bound Tritium. The activity concentrations of both species were traceable to national standards of radioactivity.

2.5.4.2 Carbon-14
This nuclide is formed by interaction of ^{14}N with neutrons produced in the upper atmosphere by cosmic-ray interactions. It undergoes beta minus decay (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 B2 samples was carbonate. The carbon-14 source was traceable to a national standard of radioactivity.

2.5.4.3 Chlorine-36
This nuclide is produced by neutron activation of ^{35}Cl. It decays by beta minus emissions (E_{max} = 709 keV) to ^{36}Ar (98.1%) and by electron capture (1.9%) and beta plus emissions (0.0015%) to ^{36}S. It occurs in some environmental samples, due to discharges from the nuclear industry. The chemical form of ^{36}Cl in the B2 samples was chloride. Chlorine-36 was standardised by liquid scintillation counting (using CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.4.4 Iodine-129
This long-lived fission product undergoes beta minus decay (E_{max} = 151 keV) to the 39.6 keV exited level of ^{129}Xe. It occurs in some marine environmental samples, due to discharges from the nuclear industry. The chemical form of ^{129}I in the B2 samples was iodide. Iodine-129 was standardised by liquid scintillation counting (using CIEMAT / NIST efficiency tracing with ^{3}H).

2.5.5 C samples

The nuclides listed below were the principal radionuclides present in the C samples.

2.5.5.1 Hydrogen-3 (Tritium)

This nuclide is produced in concrete by neutron activation of hydrogen (^{2}H), lithium (^{6}Li) and boron (^{10}B). It undergoes beta minus decay (E_{max} = 18.6 keV) to ^{3}He.

2.5.5.2 Carbon-14

This nuclide is produced in concrete by neutron activation of carbon (^{13}C), nitrogen (^{14}N and ^{15}N) and oxygen (^{16}O and ^{17}O). It undergoes beta minus decay (E_{max} = 156 keV) to ^{14}N.

2.5.5.4 Potassium-40

This naturally-occurring radionuclide decays by via electron capture (10.86%) mainly to the excited level of ^{40}Ar (1460 keV) and by beta minus emissions (89.14%) to ^{40}Ca.

2.5.5.3 Calcium-41

This nuclide is produced in concrete by neutron activation of calcium (^{40}Ca). It decays via electron capture to ^{41}K.

2.5.5.5 Iron-55

This nuclide is produced in concrete by neutron activation of iron (^{54}Fe). It decays via electron capture to ^{55}Mn.

2.5.5.6 Cobalt-60

This nuclide is produced in concrete by neutron activation of cobalt (^{59}Co). It undergoes beta minus decay to excited levels of ^{60}Ni. This nuclide may show coincidence summing effects on high efficiency detectors.

2.5.5.7 Nickel-63

This nuclide is produced in concrete by neutron activation of nickel (^{62}Ni). It undergoes beta minus decay (E_{max} = 67 keV) to ^{63}Cu.

2.5.5.8 Barium-133

This nuclide is produced in concrete by activation of barium (^{134}Ba) with fast neutrons. It decays by electron capture to excited levels of ^{133}Cs. Barium-133 is well known as a nuclide which shows coincidence summing effects on high efficiency detectors.

2.5.5.9 Europium-152

This nuclide is produced in concrete by neutron activation of europium (^{151}Eu). It decays via electron capture (72.1%) to excited levels of ^{152}Sm and by beta minus emissions (27.9%) to excited levels of ^{152}Gd. Europium-152 is well known as a nuclide which shows large coincidence summing effects on high efficiency detectors.

2.5.5.10 Europium-154

This nuclide is produced in concrete by neutron activation of europium (^{153}Eu). It undergoes mainly beta minus decay (99.982%) to ^{154}Gd excited levels. Europium-154 is well known as a nuclide which shows large coincidence summing effects on high efficiency detectors.

2.6 Treatment of data for aqueous samples

The laboratory data were reported back to the participants in order for the participants to check for gross errors. The deviation from 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:		unit:
D	– deviation from the assigned value	(%)
L	– laboratory value	(Bq kg^{-1} or Bq g^{-1})
N	– assigned value	(Bq kg^{-1} or Bq g^{-1})
u_{D}	– standard uncertainty of the deviation	(%)
u_{L}	– standard uncertainty of the laboratory value	(Bq kg^{-1} or Bq g^{-1})
u_{N}	– standard uncertainty of the assigned value	(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	(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 were significantly different from zero. The interquartile (IQR) outlier test (see Table F1; Appendix H) was used to determine whether the relative uncertainty of the laboratory value R_{L} was significantly larger than the other values in the data set. This test is unable to identify outliers if the data set is smaller than 7. In case the data set is smaller than 10, any $R_{\mathrm{med}} > 0.20$ was set at 0.20, and any $R_{\mathrm{med}} < 0.05$ was set at 0.05.

Results for which the absolute values of the zeta score and the *z*-score were both ≤ 2.576 (corresponding to a significance levels of $\alpha = 0.01$) 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 (i.e., there is a large deviation from the assigned value combined with a large uncertainty), or (iii) the result passes the *z*-test but not the zeta test (where there is a small deviation from the assigned value and 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 > 2.576, then the laboratory value is classified as '**discrepant**' from the assigned value (red points), whatever the value of its relative uncertainty R_L.

Zeta test	R_L test	*z* test	Classification
pass	pass	pass	**in agreement**
pass	fail	pass	**questionable**
fail	pass	pass	**questionable**
pass	pass/fail	fail	**questionable**
fail	pass/fail	fail	**discrepant**

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 2.576. The left parabola represents the outlier limit R_{lim} of the relative laboratory uncertainty R_L.

Data points that are inside the $\zeta = 2.576$ parabola (i.e., for which $\zeta \leq 2.576$), for which $-2.576 \leq z$-score ≤ 2.576 and which are outside the R_{lim} parabola (i.e., for which $R_L \leq R_{lim}$) are designated '**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 $\zeta = 2.576$ parabola with a *z*-score < –2.576* or > 2.576,
(ii) outside the $\zeta = 2.576$ parabola with $-2.576 \leq z$-score ≤ 2.576 or
(iii) inside the $\zeta = 2.576$ parabola with $-2.576 \leq z$-score ≤ 2.576 but inside the R_{lim} parabola (i.e., for which $R_L > R_{lim}$).

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

More information on the interpretation of Kiri plots is given in Appendix G.

2.7 Treatment of data for C samples

The laboratory data were reported back to the participants in order for the participants to check for gross errors. The assigned value, the standard uncertainty of the assigned value and the standard deviation for proficiency assessment were calculated in accordance with ISO standard 13528:2005.

Calculate initial values for N^* and s^*

$$N^* = median\ of\ L_i$$

$$s^* = 1.483\ median \left| L_i - N^* \right|$$

Update the values of N^* and s^* as follows. Calculate:

$$\delta = 1.5\ s^*$$

For each L_i, calculate:

$$L_i^* = \begin{cases} N^* - \delta & \text{if } L_i < N^* - \delta \\ N^* + \delta & \text{if } L_i < N^* + \delta \\ L_i & \text{otherwise} \end{cases}$$

Calculate the new values of N^* and s^*

$$N^* = \sum \frac{L_i^*}{p}$$

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

$$s^* = 1.134 \sqrt{\frac{\sum \left(L_i^* - N^*\right)^2}{p-1}}$$

where the summation is over i.

The robust estimates N^* and s^* are derived by an iterative calculation, i.e., by updating the values of N^* and s^* several times using the modified data, until the process converges. Subsequently, the updated value of the robust mean N^* is assigned to the assigned value N.

$$N = N^*$$

The standard uncertainty of the consensus value is calculated using this equation.

$$u_{cons} = 1.25 \frac{s^*}{\sqrt{p}} = 1.42 \sqrt{\frac{\sum \left(L_i^* - N^*\right)^2}{p(p-1)}}$$

The updated value for the standard deviation s^* is assigned to the standard deviation for proficiency assessment.

$$\sigma_p = s^*$$

Finally, the standard uncertainty of the assigned value is calculated by combining the standard uncertainty of the consensus value with the homogeneity uncertainty (see Section 2.8).

The results were evaluated using three tests:

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

$$R_L = \frac{u_{\mathrm{L}}}{L}$$

$$z = \frac{L - N}{\sigma_p}$$

where:		unit:
L	– laboratory value	(Bq g^{-1})
N	– assigned value	(Bq g^{-1})
N^*	– robust estimate of the assigned value	(Bq g^{-1})
s^*	– robust estimate of standard deviation	(Bq g^{-1})
u_L	– standard uncertainty of the laboratory value	(Bq g^{-1})
u_{cons}	– standard uncertainty of the consensus value	(Bq g^{-1})
u_N	– standard uncertainty of the assigned value	(Bq g^{-1})
σ_p	– standard deviation for proficiency assessment	(Bq g^{-1})
ζ	– zeta score	
R_L	– relative uncertainty of the laboratory value	
z	– z-score	

The interquartile (IQR) outlier test (see Table H1; Appendix H) 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 ≤ t (corresponding to a significance levels of α = 0.01; see Appendix J) 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 > t, then the laboratory value is classified as '**discrepant**' from the assigned value (red points), whatever the value of its relative uncertainty R_L.

Zeta test	R_L test	*z* test	Classification
pass	pass	pass	**in agreement**
pass	fail	pass	**questionable**
fail	pass	pass	**questionable**
pass	pass/fail	fail	**questionable**
fail	pass/fail	fail	**discrepant**

2.8 Homogeneity testing of C samples

Fourteen randomly selected samples were kept at NPL and measured by high-resolution gamma spectrometry. The between-sample variance was determined by measuring all samples (n = 14) once, while the measurement variance was determined by measuring a single sample m times (m = 5). For each sample, decay-corrected count rates per unit mass x_i or x_j for ^{60}Co (1173 keV peak), ^{133}Ba (356 keV peak), ^{152}Eu (964 keV peak) and ^{154}Eu (1274 keV peak) with their corresponding counting uncertainties u_i or u_j were determined. The homogeneity uncertainty was calculated as the difference between the between-sample variance and either (i) the measurement variance or (ii) the squared mean of the counting uncertainties (whichever was greater). In cases where the between-sample variance was smaller than either the measurement variance or the squared mean of the counting uncertainties, the value of relative homogeneity uncertainty was set to zero. The uncertainty of the assigned value u_N was obtained by quadrature summation of the relative homogeneity uncertainty and the relative uncertainty on the consensus value.

$$s_{bb} = \sqrt{\frac{\sum_i (x_i - \bar{x}_i)^2}{n-1}} \left(\frac{100}{\bar{x}_i} \right)$$

$$u_\mathrm{meas} = \frac{s_x}{\sqrt{m}} = \sqrt{\frac{\sum_j (x_j - \bar{x}_j)^2}{m(m-1)}} \left(\frac{100}{\bar{x}_j} \right)$$

$$u_\mathrm{int} = 100\ mean\left(\frac{u_j}{x_j} \right)$$

$$u_\mathrm{hom}^2 = s_{bb}^2 - u_{meas}^2 \qquad \text{or} \qquad u_\mathrm{hom}^2 = s_{bb}^2 - u_\mathrm{int}^2 \qquad \text{(whichever gives the lower result)}$$

$$u_{N,\,rel}^2 = u_\mathrm{cons}^2 + u_\mathrm{hom}^2$$

$$u_N = \frac{u_{N,rel}\ N}{100}$$

where:		unit:
n	– number of samples tested	
x_i	– decay-corrected count rate per unit mass for sample i	(cps g^{-1})
s_{bb}	– relative standard deviation of x_i	(%)
m	– number of measurements on single selected sample	
x_j	– decay-corrected count rate per unit mass for sample j	(cps g^{-1})
u_j	– standard uncertainty of x_j	(cps g^{-1})
s_x	– relative standard deviation of x_j	(%)
u_meas	– relative measurement uncertainty	(%)
u_int	– mean of the relative uncertainties of x_j	(%)
u_hom	– relative homogeneity uncertainty	(%)
u_cons	– standard uncertainty of the consensus value	(%)
$u_{N,rel}$	– relative uncertainty of the assigned value N	(%)

2.9 Comparison of the assigned values with the participants' values

The robust means and the robust standard deviations for the participants' results were calculated in accordance with the method described in Section 2.7 and subsequently compared with the assigned values (except for the nuclides in the C samples where the robust means are equal to the assigned values). The robust mean N^* was tested against the assigned value N using this equation:

$$t = \frac{N^* - N}{\sqrt{(u_N)^2 + (u_N^*)^2}}$$

The effective degrees of freedom v_{eff} were determined with the simplified Welch-Satterthwaite equation (it is assumed that the degrees of freedom for u_N are infinite).

$$v_{eff} = \frac{\left((u_N)^2 + (u_N^*)^2\right)^2}{(u_N^*)^4}(n-1)$$

The effective degrees of freedom v_{eff} were rounded and t_{crit} was identified from the values tabulated in Appendix J. The criteria for passing the t test is:

$$-t_{crit} < t < t_{crit}$$

If the value of t lies outside this range, this indicates there is a significant difference between the participants' results and the assigned value.

2.10 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 format xxx(y), where the number in parentheses is the numerical value of the standard uncertainty referred to the corresponding last digits of the quoted result.

2.11 Nuclear data

This was not supplied to the participants, but currently recommended values for half-life data are given in Appendix I 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 results. 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.

2.12 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 15 December 2006 (12:00 GMT). The ratio between ^{95}Nb and ^{95}Zr at the reference time was 1.752(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.

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

$$+ \; (R_1 + R_2)$$

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

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 April 2007 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 AL and AH samples

3.1.1 Radium-226

Radium-226 can be measured by a variety of measurement techniques: these include alpha spectrometry, liquid scintillation counting, gas-flow proportional counting, gamma spectrometry and emanation techniques. The main difficulty in measuring the ^{226}Ra activity concentration with alpha spectrometry or liquid scintillation is the need for a radiochemical separation from the other radionuclides present in the sample.

Fourteen results were reported for the AL samples (see Figures 1A to 1D). Nine results are in agreement with the assigned value, while two results are questionable. Three results are discrepant. The reported results show no significant bias. Four participants (Labs 8, 38, 47 and 66) used alpha spectrometry to determine ^{226}Ra, while three participants (Labs 26, 40 and 42) used gamma spectrometry, four participants (Labs 22, 28, 34 and 73) used liquid scintillation counting, three participants (Labs 25, 35 and 68) used gas-flow proportional counting and one participant (Lab 65) used an emanation technique. Barium-133 was the most popular yield tracer (Labs 25, 34, 35, 38 and 66), followed by ^{223}Ra (Lab 47) and stable Ba (Lab 68). A variety of separation techniques was used to separate ^{226}Ra from the matrix: precipitation techniques (Labs 25, 26, 35, 38, 66, 68 and 73), ion-exchange chromatography (Labs 8 and 47), extraction chromatography (Lab 47) and disk filtration (Lab 22).

Reported **AL** results:	14
In agreement with the assigned value:	9
Questionable result:	2
Discrepant from the assigned value:	3

Fourteen results were reported for the AH samples (see Figures 9A to 9D). Eight results are in agreement with the assigned value, while three results are questionable. Three results are discrepant. The reported results show no significant bias. Four participants (Labs 8, 32, 47 and 66) used alpha spectrometry to determine ^{226}Ra, while five participants (Labs 17, 21, 32, 55 and 69) used gamma spectrometry, three participants (Labs 22, 28 and 73) used liquid scintillation counting and two participants (Labs 35 and 46) used gas-flow proportional counting. Barium-133 was the most popular yield tracer (Labs 35, 66 and 69), followed by ^{223}Ra (Lab 47), ^{224}Ra (Lab 32) and stable Ba (Lab 46). A variety of separation techniques was used to separate ^{226}Ra from the matrix: precipitation techniques (Labs 35, 46, 66, 69 and 73), ion-exchange chromatography (Labs 8, 32 and 47), extraction chromatography (Lab 47) and disk filtration (Lab 22).

Reported **AH** results:	14
In agreement with the assigned value:	8
Questionable result:	3
Discrepant from the assigned value:	3

3.1.2 Neptunium-237

Neptunium-237 can be measured by three independent techniques: these include alpha spectrometry, gamma spectrometry and mass spectrometry. The main difficulty in measuring the ^{237}Np activity concentration with alpha spectrometry and mass spectrometry is the need for a radiochemical separation from the other radionuclides present in the sample (in case of alpha spectrometry this is especially true of the ^{226}Ra 4.60 MeV and 4.78 MeV peaks which interfere with the 4.65 MeV and 4.78 MeV peaks of ^{237}Np).

Four results were reported for the AL samples (see Figures 2A to 2D). Two results are in agreement with the assigned value. Two results are discrepant. The reported results show no significant bias. One participant (Lab 34) used both alpha spectrometry and mass spectrometry to determine ^{237}Np, while other participants used gamma spectrometry (Lab 42), alpha spectrometry (Lab 66) and mass spectrometry (Lab 38).

Reported **AL** results:	4
In agreement with the assigned value:	2
Questionable result:	0
Discrepant from the assigned value:	2

Seven results were reported for the AH samples (see Figures 10A to 10D). Six results are in agreement with the assigned value, while one result is questionable. The reported results show no significant bias. Three participants used gamma spectrometry to determine ^{237}Np (Labs 21, 32 and 55), while two used mass spectrometry (Labs 8 and 47) and two used alpha spectrometry (Labs 14 and 66).

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

3.1.3 Uranium-238

Uranium-238 can be measured by four independent techniques: these include alpha spectrometry, gamma spectrometry, X-ray fluorescence 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.

Twenty-one results were reported for the AL samples (see Figures 3A to 3D). Fifteen results are in agreement with the assigned value, while three results are questionable. Three results are discrepant. The reported results show no significant bias. Most participants used alpha spectrometry to determine ^{238}U, while three participants (Labs 8, 34 and 47) used mass spectrometry. Most participants who used alpha spectrometry as the detection method used ion-exchange chromatography to separate the ^{238}U from the matrix. Six participants (Labs 4, 22, 26, 29, 65 and 71) used extraction chromatography. Most participants used ^{232}U as the yield tracer, while two participants (Labs 38 and 47) used ^{236}U, one participant (Lab 8) used ^{226}Ra and ^{233}U parallel standards and one participant (Lab 47) used a ^{175}Lu internal mass spectrometry standard. There is some evidence that there are differences between the results obtained from the two techniques used (with mass spectrometry giving higher but not necessarily more accurate results).

Reported **AL** results:	21
In agreement with the assigned value:	15
Questionable results:	3
Discrepant from the assigned value:	3

Sixteen results were reported for the AH samples (see Figures 11A to 11D). Thirteen results are in agreement with the assigned value, while one result is questionable. Two results are discrepant. The reported results show no significant bias. Most participants used alpha spectrometry to determine ^{238}U, while four participants (Labs 8, 32, 47 and 55) used mass spectrometry, one participant (Lab 21) used gamma spectrometry, and one participant (Lab 47) used X-ray fluorescence, respectively. Most participants who used alpha spectrometry as the detection method used ion-exchange chromatography to separate the ^{238}U from the matrix. Two participants (Labs 22 and 32) used extraction chromatography. Most participants used ^{232}U as the yield tracer, while one participant (Lab 47) used ^{236}U, two participants (Lab 8 and 55) used ^{233}U, one participant (Lab 47) used rubidium (XRF), one participant (Lab 38) used a ^{209}Bi internal mass spectrometry standard) and one participant (Lab 47) used a ^{175}Lu internal mass spectrometry standard, respectively. There is some evidence that there are differences between the results obtained from the various techniques used (with mass spectrometry giving higher and, in this case, more accurate results).

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

3.1.4 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 by gamma spectrometry, although the emission probability for the 43 keV peak is only 0.0397(8)%.

Twenty results were reported for the AL samples (see Figures 4A to 4D). Eighteen results are in agreement with the assigned value. Two results (Labs 26 and 40) are discrepant. The ^{239}Pu results of these labs were also discrepant and too low, indicating a systematic problem (e.g., their yield tracer). The reported results show no significant bias. All participants used alpha spectrometry to determine ^{238}Pu. Most participants used ion-exchange chromatography to separate the ^{238}Pu from the matrix. Two participants (Labs 26 and 71) used extraction chromatography. Four participants (Labs 25, 47, 65 and 71) used ^{236}Pu as the yield tracer, while the other participants used ^{242}Pu. Most participants who used alpha spectrometry as the detection method used electrodeposition to prepare the ^{238}Pu sources. Labs 26, 65 and 66 used microprecipitation (LaF_3 and NdF_3). There is no indication that there are significant differences between the results obtained from the various techniques used.

Reported **AL** results:	20
In agreement with the assigned value:	18
Questionable results:	0
Discrepant from the assigned value:	2

Thirteen results were reported for the AH samples (see Figures 12A to 12D). Ten results are in agreement with the assigned value, while three results are questionable. The reported results show no significant bias. All participants used alpha spectrometry to determine ^{238}Pu, except Lab 55 who used a combination of alpha scintillation counting, alpha pulse height spectrometry and low energy photon spectrometry. Most participants who used alpha spectrometry as the detection method separated the ^{238}Pu from the matrix by ion-exchange chromatography. One participant (Labs 14) used extraction chromatography. Two participants (Labs 32 and 47) used ^{236}Pu as the yield tracer, while the other participants, except Lab 55, used ^{242}Pu. Most participants who used alpha spectrometry as the detection method used electrodeposition to prepare the ^{238}Pu sources. Labs 14 and 66 used microprecipitation (NdF_3). There is no indication that there is a significant difference between the results obtained from the various techniques used.

Reported **AH** results:	13
In agreement with the assigned value:	10
Questionable result:	3
Discrepant from the assigned value:	0

3.1.5 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. Twenty results were reported for the AL samples (see Figures 5A to 5D). Eighteen results are in agreement with the assigned value. Two results (Labs 26 and 40) are discrepant. The ^{238}Pu results of these labs were also discrepant and too low, indicating a systematic problem (e.g., with their yield tracer). The reported results show no significant bias. All participants used alpha spectrometry to determine ^{239}Pu. Most participants used ion-exchange chromatography to separate the ^{239}Pu from the matrix. Two participants (Labs 26 and 71) used extraction chromatography. Four participants (Labs 25, 47, 65 and 71) used ^{236}Pu as the yield tracer, while the other participants used ^{242}Pu. Most participants who used alpha spectrometry as the detection method used electrodeposition to prepare the ^{239}Pu sources. Labs 26, 65 and 66 used microprecipitation (LaF_3 and NdF_3). There is no indication that there are significant differences between the results obtained from the various techniques used.

Reported **AL** results:	20
In agreement with the assigned value:	18
Questionable result:	0
Discrepant from the assigned value:	2

Thirteen results were reported for the AH samples (see Figures 13A to 13D). Ten results are in agreement with the assigned value, while three results are questionable. The reported results show no significant bias. All participants used alpha spectrometry to determine ^{239}Pu, except Lab 55 who used a combination of alpha scintillation counting, alpha pulse height spectrometry and low energy photon spectrometry. Most participants who used alpha spectrometry as the detection method separated the ^{239}Pu from the matrix by ion-exchange chromatography. One participant (Labs 14) used extraction chromatography. Two participants (Labs 32 and 47) used ^{236}Pu as the yield tracer, while the other participants, except Lab 55, used ^{242}Pu. Most participants who used alpha spectrometry as the detection method used electrodeposition to prepare the ^{239}Pu sources. Labs 14 and 66 used microprecipitation (NdF_3). There is no indication that there are significant differences between the results obtained from the various techniques used.

Reported **AH** results:	13
In agreement with the assigned value:	10
Questionable result:	3
Discrepant from the assigned value:	0

3.1.6 Americium-241

Americium-241 can be measured by three independent techniques: these include 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).

Twenty-one results were reported for the AL samples (see Figures 6A to 6D). Eighteen results are in agreement with the assigned value, while one result is questionable. Two results are discrepant. The reported results show no significant bias. The large majority of the participants used alpha spectrometry to determine ^{241}Am (with ^{243}Am as the yield tracer). Two participants (Labs 22 and 42) used gamma spectrometry. Most participants who used alpha spectrometry as the detection method separated the ^{241}Am from the matrix by extraction chromatography. Seven participants (Labs 8, 13, 25, 28, 35, 38 and 66) used ion-exchange chromatography. Most participants who used alpha spectrometry as the detection method used electrodeposition to prepare the ^{241}Am sources. Labs 26, 65 and 66 used microprecipitation (LaF_3 and NdF_3).

Reported **AL** results:	21
In agreement with the assigned value:	18
Questionable result:	1
Discrepant from the assigned value:	2

Seventeen results were reported for the AH samples (see Figures 14A to 14D). Thirteen results are in agreement with the assigned value, while two results are questionable. Two results are discrepant. The reported results show no significant bias. The majority of the participants used alpha spectrometry to determine ^{241}Am (with ^{243}Am as the yield tracer). Five participants (Labs 8, 21, 22, 32 and 55) used gamma spectrometry. Most participants who used alpha spectrometry as the detection method separated ^{241}Am with extraction chromatography. Four participants (Labs 7, 35, 41 and 66) used ion-exchange chromatography, while one participant used solid phase extraction (Lab 14). Most participants who used alpha spectrometry as the detection method used electrodeposition to prepare the ^{241}Am sources. Labs 14 and 66 used microprecipitation (NdF_3).

Reported **AH** results:	17
In agreement with the assigned value:	13
Questionable result:	2
Discrepant from the assigned value:	2

3.1.7 Curium-244

The main difficulty in measuring the ^{244}Cm activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample and the absence of a suitable curium yield tracer. Sixteen results were reported for the AL samples (see Figures 7A to 7D). Eight results are in agreement with the assigned value while three results are questionable. Five results are discrepant. The reported results show no significant bias. All participants used alpha spectrometry to determine ^{244}Cm with most sources prepared by electrodeposition (except Labs 65 and 66 who used lanthanide fluoride microprecipitation). Participants used ion-exchange chromatography, liquid extraction and extraction chromatography to separate the ^{244}Cm from the matrix. There is no indication that there are significant differences between the results obtained from the various techniques used. Almost all participants used ^{243}Am as the yield tracer. In most cases, the normalised ^{244}Cm / ^{241}Am ratio obtained by the labs (see Figure 138A) is lower than unity which may indicate a chemical separation of ^{244}Cm from its yield tracer ^{243}Am during the separation and/or source preparation procedure. This ^{244}Cm and ^{243}Am separation may explain the low and discrepant/questionable results of Labs 17, 8, 71, 65, 38 and 73. The questionable and discrepant results of Labs 40 and 66 cannot be explained by this since their normalised ^{244}Cm / ^{241}Am ratios were very close to unity.

Reported **AL** results:	16
In agreement with the assigned value:	8
Questionable result:	3
Discrepant from the assigned value:	5

Thirteen results were reported for the AH samples (see Figures 15A to 15D). Five results are in agreement with the assigned value, while three results are questionable. Five results are discrepant. The reported results show a negative bias. All participants used alpha spectrometry to determine ^{244}Cm. All participants used alpha spectrometry to determine ^{244}Cm with most sources prepared by electrodeposition (except Labs 14 and 66 who used lanthanide fluoride microprecipitation). Participants used ion-exchange chromatography, liquid extraction and extraction chromatography to separate the ^{244}Cm from the matrix. There is no indication that there are significant differences between the results obtained from the various techniques used. Almost all participants used ^{243}Am as the yield tracer. In most cases, the normalised ^{244}Cm / ^{241}Am ratio obtained by the labs (see Figure 138B) were lower than unity which may indicate a chemical separation of ^{244}Cm from its yield tracer ^{243}Am during the separation and/or source preparation procedure. This ^{244}Cm and ^{243}Am separation may explain the low and discrepant/questionable results of Labs 14, 55, 17 and 8. However, other questionable and discrepant results (Labs 47, 35, 41 and 66) cannot be explained by this since their normalised ^{244}Cm / ^{241}Am ratios were very close to unity.

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

3.1.8 Gross alpha

The main difficulty in measuring the gross alpha activity concentration is the possibility that some volatile radionuclides (i.e., ^{210}Po, ^{214}Po, ^{218}Po and ^{222}Rn) may be lost during the sample preparation.

Five results were reported for the AL samples (see Figures 8A to 8D). One result is in agreement with the assigned value, while two result are questionable. Two results are discrepant. The reported results show no significant bias. The only result that was "in agreement" (Lab 65) was obtained using a ZnS scintillation detector. The other four results (which were all either "questionable" or "discrepant") were obtained using a gas-flow proportional counter.

Reported **AL** results:	5
In agreement with the assigned value:	1
Questionable result:	2
Discrepant from the assigned value:	2

Two results were reported for the AH samples (see Figures 16A to 16D). Both results are in agreement with the assigned value. One participant (Lab 32) used a gas-flow proportional counter, while the other participant (Lab 55) used "alpha count". The reported results show no significant bias.

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

3.2 BL and BH samples

3.2.1 Hydrogen-3

The main difficulty in measuring the ^{3}H activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Fifteen results were reported for the BL samples (see Figures 17A to 17D). Seven results are in agreement with the assigned value, while one result is questionable. Seven results are discrepant. All participants used liquid scintillation counting. The large majority of the participants used distillation as the separation technique (except Labs 5C and 17 who both used combustion). The reported results show no significant bias.

Reported **BL** results:	15
In agreement with the assigned value:	7
Questionable results:	1
Discrepant from the assigned value:	7

Sixteen results were reported for the BH samples (see Figures 24A to 24D). Eleven results are in agreement with the assigned value, while three results are questionable. Two results are discrepant. All participants used liquid scintillation counting. The large majority of the participants used distillation as the separation technique (except Labs 5C and 38C who both used combustion and Labs 30 and 66 who did not separate tritium). It is clear that not separating tritium resulted in high and discrepant results. The reported results show no significant bias.

Reported **BH** results:	16
In agreement with the assigned value:	11
Questionable result:	3
Discrepant from the assigned value:	2

3.2.2 Iron-55

The main difficulties 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).

Two results were reported for the BL samples (see Figures 18A to 18D). Both results are in agreement with the assigned value. Both participants used liquid scintillation counting as the detection technique. Lab 32 used liquid extraction to separate the ^{55}Fe from the matrix, while Lab 34 used a combination of precipitation and ion-exchange chromatography. The reported results show no significant bias.

Reported **BL** results:	2
In agreement with the assigned value:	2
Questionable results:	0
Discrepant from the assigned value:	0

Seven results were reported for the BH samples (see Figures 25A to 25D). Four results are in agreement with the assigned value, while one result is questionable. Two results are discrepant. The reported results show a negative bias. There is some indication that the detection method [liquid scintillation counting (Labs 38, 55, 74 and 78) or gamma- or X-ray spectrometry (Labs 7, 21 and 30)] led to a significant difference between the results, with the LSC results in general being more accurate than the gamma- or X-ray spectrometry results. Furthermore, the participants who also reported ^{63}Ni values (Labs 7, 38, 74 and 78) obtained more accurate results than the three other participants who had not.

Reported **BH** results:	7
In agreement with the assigned value:	4
Questionable result:	1
Discrepant from the assigned value:	2

3.2.3 Nickel-63

The main difficulty in measuring the ^{63}Ni activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Four results were reported for the BL samples (see Figures 19A to 19D). Two results are in agreement with the assigned value, while one result is questionable. One result is discrepant. The reported results show no significant bias. All participants used liquid scintillation counting. There is some indication that the radiochemical separation technique [DMG precipitation (Labs 66 and 73), ion-exchange chromatography (Lab 34) and a combination of ion-exchange chromatography and Ni-extraction chromatography (Lab 32)] led to a significant difference between the results. The participants who also reported ^{55}Fe values (Labs 32 and 34) obtained more accurate results than the two participants who had not.

Reported **BL** results:	4
In agreement with the assigned value:	2
Questionable results:	1
Discrepant from the assigned value:	1

Six results were reported for the BH samples (see Figures 26A to 26D). Three results are in agreement with the assigned value. Three results are discrepant. The reported results show no significant bias. All participants used liquid scintillation counting. There is some indication that the radiochemical separation technique [DMG precipitation (Labs 66 and 73), extraction combined with ion-exchange chromatography (Lab 7) and Ni-extraction chromatography (Labs 38, 74 and 78)] led to a significant difference between the results. A total of 75% of the participants (both the BL and BH sample types) who had used Ni-extraction chromatography were in agreement with NPL, compared to only 25% of the participants (again, both BL and BH) who had used DMG precipitation.

Reported **BH** results:	6
In agreement with the assigned value:	3
Questionable result:	0
Discrepant from the assigned value:	3

3.2.4 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 Cerenkov and LSC counting and/or spectral deconvolution.

Six results were reported for the BL samples (see Figures 20A to 20D). Four results are in agreement with the assigned value, while one reported result is questionable. One result is discrepant. The reported results show no significant bias. All participants used either liquid scintillation counting or Cerenkov counting. There is no indication that the nature of the yield tracer [the gamma-emitter ^{85}Sr (Labs 22M, 22E, 40 and 66) or stable Sr (Labs 3 and 32)] nor the radiochemical separation technique [extraction chromatography (Labs 3, 22E, 32 and 40), precipitation (Lab 66) or disk filtration (Lab 22M)] led to any significant differences between the results.

Reported **BL** results:	6
In agreement with the assigned value:	4
Questionable results:	1
Discrepant from the assigned value:	1

Eight results were reported for the BH samples (see Figures 27A to 27D). Four results are in agreement with the assigned value, while one result is questionable. Three results are discrepant. The reported results show no significant bias. There is no indication that the detection method [liquid scintillation counting or Cerenkov counting (Labs 22M, 22E 30, 38, 55 and 66) or gas-flow proportional counting (Labs

14 and 78)], the nature of the yield tracer [none (Lab 30), ^{85}Sr (Labs 22M, 22E, 38, 55 and 66) or stable Sr (Labs 14 and 78)], nor the radiochemical separation technique [none (Lab 30), extraction chromatography (Labs 14, 22E and 38), precipitation (Lab 55), cation-exchange chromatography (Lab 78) or disk filtration (Lab 22M)] led to any significant differences between the results.

Reported **BH** results:	8
In agreement with the assigned value:	4
Questionable result:	1
Discrepant from the assigned value:	3

3.2.5 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 Cerenkov and LSC counting and/or spectral deconvolution.

Sixteen results were reported for the BL samples (see Figures 21A to 21D). Eleven results are in agreement with the assigned value, while four results are questionable. One result is discrepant. The reported results show no significant bias. Most participants used LSC or Cerenkov counting to detect ^{90}Sr or its daughter ^{90}Y, while five participants (Labs 8, 13, 25, 28 and 35) used gas flow proportional counting and one participant (Lab 34) used a Geiger Müller counter. Most participants used ^{85}Sr as the yield tracer for ^{90}Sr, with the exception of Lab 25 (no tracer), Labs 3, 32 and 35 (stable Sr), Labs 8, 75 and 76 (stable Y) and Labs 73 and 73E (no information provided). The most popular method for separating ^{90}Sr from the matrix was extraction chromatography, with the exception of Lab 34 (no information provided), Labs 73, 75 and 76 (extraction), Labs 13, 25 and 66 (precipitation techniques), Lab 22M (disk filtration) and Lab 28 (ion-exchange chromatography). Three participants isolated only ^{90}Y (Labs 8, 75 and 76) and determined the ^{90}Sr activity concentration indirectly. There is no indication that either the detection method, the nature of the yield tracer or the radiochemical separation technique led to any significant differences between the results. The participants who also reported ^{89}Sr values (Labs 3, 22M, 22E, 32, 40 and 66) did not obtain more accurate (or less accurate) results than the participants who had not.

Reported **BL** results:	16
In agreement with the assigned value:	11
Questionable results:	4
Discrepant from the assigned value:	1

Fifteen results were reported for the BH samples (see Figures 28A to 28D). Seven results are in agreement with the assigned value, while two results are questionable. Six results are discrepant. The reported results show no significant bias. Most participants used LSC or Cerenkov counting to detect ^{90}Sr or its daughter ^{90}Y, while four participants (Labs 14, 28, 74 and 78) used gas flow proportional counting. Most participants used ^{85}Sr as the yield tracer for ^{90}Sr, with the exception of Lab 30 (no tracer), Labs 74 and 78 (stable Sr), Labs 14 and 74 (stable Y) and Labs 8, 73 and 73E (no information). The most popular method for separating ^{90}Sr was extraction chromatography, with the exception of Lab 30 (no separation), Labs 14 and 73 (extraction), Labs 55, 66 and 74 (precipitation techniques), Lab 22M (disk filtration) and Lab 7, 28 and 78 (ion-exchange chromatography). Two participants isolated only ^{90}Y (Labs 14 and 73) and determined the ^{90}Sr activity concentration indirectly. There is no indication that either the detection method, the nature of the yield tracer or the radiochemical separation technique led to any significant differences between the results. The participants who also did report ^{89}Sr values (Labs 14, 22E, 22M, 30, 38, 55, 66 and 78) in general obtained lower results than the participants who had not.

Reported **BH** results:	15
In agreement with the assigned value:	7
Questionable result:	2
Discrepant from the assigned value:	6

3.2.6 Technetium-99

The main difficulty in measuring the ^{99}Tc activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Nine results were reported for the BL samples (see Figures 22A to 22D). Six results are in agreement with the assigned value, while two results are questionable. One result is discrepant. The reported results show no significant bias. There is no indication that either the detection method [liquid scintillation counting (Labs 35 and 66), gas-flow proportional counting (Labs 13, 28, 53 and 76), GM counting (Lab 34) or mass spectrometry (Lab 32)] or the radiochemical separation technique (a wide variety of precipitation techniques, extraction, ion-exchange chromatography and extraction (TEVA) chromatography) led to any significant differences between the results. However, the participants who used ^{99m}Tc as the yield tracer (Labs 28, 34, 35 and 53) obtained more accurate results than the participants who used either stable rhenium (Labs 13, 32 and 76) or no yield tracer (Labs 8 and 66).

Reported **BL** results:	9
In agreement with the assigned value:	6
Questionable results:	2
Discrepant from the assigned value:	1

Seven results were reported for the BH samples (see Figures 29A to 29D). Five results are in agreement with the assigned value, while one result is questionable. One result is discrepant. The reported results show no significant bias. There is no indication that either the detection method [liquid scintillation counting (Labs 38, 55, 66 and 74) or gas-flow proportional counting (Labs 8, 28 and 46)] or the radiochemical separation technique (a wide variety of precipitation techniques, extraction, ion-exchange chromatography and extraction (TEVA) chromatography) led to any significant differences between the results. However, the participants who either used ^{99m}Tc (Labs 28, 38, 55 and 74) or stable rhenium (Lab 46) as the yield tracer obtained more accurate results than the participants who used no yield tracer (Labs 8 and 66).

Reported **BH** results:	7
In agreement with the assigned value:	5
Questionable result:	1
Discrepant from the assigned value:	1

3.2.7 Gross beta

The main difficulty in measuring the gross beta activity concentration is the possibility that some radionuclides may be either lost during the sample preparation (e.g., ^{3}H) or measured with a low efficiency due to self-absorption or quenching (e.g., ^{3}H, ^{55}Fe, ^{63}Ni and ^{99}Tc).

Four results were reported for the BL samples (see Figures 23A to 23D). Three results are in agreement with the assigned value, while one result is questionable. The reported results show no significant bias. Three participants (Labs 25, 40 and 56) used a gas-flow proportional counter, while one participant (Lab 3) used liquid scintillation counting. There is no indication that the detection method led to any significant differences between the results.

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

Two results were reported for the BH samples (see Figures 30A to 30D). One result (Lab 78; gas-flow proportional counting) is in agreement with the assigned value, while one result (Lab 85; liquid scintillation counting) is questionable. The reported results show no significant bias.

Reported **BH** results:	2
In agreement with the assigned value:	1
Questionable result:	1
Discrepant from the assigned value:	0

3.3 B2 samples

3.3.1 Hydrogen-3 (HTO)

The main difficulty in measuring the tritiated water activity concentration is the need for a radiochemical separation from OBT, ^{14}C, ^{36}Cl and ^{129}I.

Fourteen results were reported for HTO (see Figures 31A to 31D), with one participant (Lab 34) reporting the total tritium activity. The large majority of the participants (all except Lab 34) used distillation to separate tritium from OBT and the other nuclides. All participants used liquid scintillation counting as the detection method. None of the results is in agreement with the assigned value, while two results are questionable. Twelve results are discrepant. The reported results show a positive bias.

It was decided to re-evaluate these results against the sum of the assigned values of tritiated water and Organically Bound Tritium (OBT) (i.e., total tritium), because OBT decomposition[#] during preparation of the mixed source and/or the sample analysis may have occurred, resulting in an increase of the HTO concentration (see Figures 31A* to 31D*). The ^{14}C source (see Section 3.3.3) used to prepare the mixed source contained formaldehyde which may have reacted with the thymidine. Nine of

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[#] See Harms, A.V., Jerome, S.M. 2004. Development of an Organically Bound Tritium Standard. Applied Radiation and Isotopes, 61, 389-393.

the re-evaluated results (labelled *) are in agreement with the assigned value, while one re-evaluated result is questionable. Four re-evaluated results are discrepant. The re-evaluated results still show a positive bias. The re-evaluated results were used in the final evaluation of the labs' results.

Reported results:	14*	(14)
In agreement with the assigned value:	9*	(0)
Questionable results:	1*	(2)
Discrepant from the assigned value:	4*	(12)

3.3.2 Hydrogen-3 (OBT)

The main difficulty in measuring the OBT concentration is the need for a radiochemical separation from HTO, ^{14}C, ^{36}Cl and ^{129}I.

Three results were reported for OBT (see Figures 32A to 32D). None of the results is in agreement with the assigned value, while one result is questionable. Two results are discrepant. The reported results show no significant bias. All participants used liquid scintillation counting as the detection method. Because of problems discussed above (Section 3.3.1), it was decided not to include the OBT results in the final evaluation of the labs' results.

Reported results:	(3)
In agreement with the assigned value:	(0)
Questionable results:	(1)
Discrepant from the assigned value:	(2)

3.3.3 Carbon-14

The main difficulty in measuring the ^{14}C activity concentration is the need for a radiochemical separation from ^{3}H, ^{36}Cl and ^{129}I.

Thirteen results were reported for this nuclide (see Figures 33A to 33D). Four results are in agreement with the assigned value, while one result is questionable. Eight results are discrepant. The reported results show no significant bias. Seven participants (i.e., Labs 5, 7, 13, 16, 25, 40 and 75) used $[^{14}C]O_2$ gas generation (either by sample combustion or the addition of acid) as the separation techniques, which did not result in more accurate results than the techniques used by the other participants (i.e., direct counting with LSC and $CaCO_3$/$BaCO_3$ precipitation, respectively). All participants used liquid scintillation counting as the detection method.

Reported results:	13
In agreement with the assigned value:	4
Questionable results:	1
Discrepant from the assigned value:	8

3.3.4 Chlorine-36

The main difficulty in measuring the ^{36}Cl activity concentration is the need for a radiochemical separation from ^{3}H, ^{14}C and ^{129}I.

Four results were reported for this nuclide (see Figures 34A to 34D). Three results are in agreement with the assigned value, while the remaining result is discrepant. The reported results show no significant bias. Two participants (Labs 8 and 34) used AgCl precipitation. Participants used liquid scintillation counting (Lab 34), Cerenkov counting (Lab 30) and gas-flow proportional counting (Lab 8) as the detection method.

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

3.3.5 Iodine-129

Iodine-129 can be measured with gamma spectrometry and liquid scintillation counting. The main difficulty in measuring the ^{129}I activity concentration with liquid scintillation counting is the need for a radiochemical separation from ^{3}H, ^{14}C and ^{36}Cl. Eleven results were reported for this nuclide (see Figures 35A to 35D). Eight results are in agreement with the assigned value. Three results are discrepant. The reported results show no significant bias. Most participants used gamma spectrometry as the detection method either direct (Labs 3, 8, 21, 30 and 38) or after a sample pretreatment step (Labs 25 and 46, who used ion-exchange chromatography followed by a PdI_2 or a AgI precipitation, respectively). Four participants (Labs 8, 34, 40 and 66) used liquid scintillation counting. The separation techniques used by these labs ranged from none (Lab 40), PbI_2 precipitation (Lab 66), ion-exchange chromatography followed by liquid / liquid extraction (Lab 8) and AgCl/AgI precipitation followed by dissolution of AgI in ammonia (Lab 34).

Reported results:	11
In agreement with the assigned value:	8
Questionable results:	0
Discrepant from the assigned value:	3

3.4 GL and GH samples

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

3.4.1 Cobalt-60

There are no specific measurement problems for this nuclide.

Forty-four results were reported for the GL samples (see Figures 36A to 36D). Thirty-nine results are in agreement with the assigned value, while three results are questionable. Two results are discrepant. The reported results show no significant bias.

Reported **GL** results:	44
In agreement with the assigned value:	39
Questionable results:	3
Discrepant from the assigned value:	2
Missing results:	1

Thirty-eight results were reported for the GH samples (see Figures 46A to 46D). Thirty-three results are in agreement with the assigned value, while four results are questionable. One result is discrepant. The reported results show no significant bias.

Reported **GH** results:	38
In agreement with the assigned value:	33
Questionable results:	4
Discrepant from the assigned value:	1
Missing results:	1

3.4.2 Zirconium-95

There are no specific measurement problems for this nuclide.

Forty-one results were reported for the GL samples (see Figures 37A to 37D). Twenty-eight results are in agreement with the assigned value, while ten results are questionable. Three results are discrepant. The reported results show no significant bias.

Reported **GL** results:	41
In agreement with the assigned value:	28
Questionable results:	10
Discrepant from the assigned value:	3
Missing results:	4

Thirty-five results were reported for the GH samples (see Figures 47A to 47D). Twenty-nine results are in agreement with the assigned value, while two results are questionable. Four results are discrepant. The reported results show no significant bias.

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

3.4.3 Niobium-95

The main difficulty in the determination of the ^{95}Nb activity concentration is the decay correction to the reference time. Lesser, but still significant difficulties are the fact that the ^{95}Nb/^{95}Zr activity ratio increases during measurement and 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.

Thirty-eight results were reported for the GL samples (see Figures 38A to 38D). Twelve results are in agreement with the assigned value, while eleven results are questionable. Fifteen results are discrepant. The reported results show a positive bias.

Reported **GL** results:	38
In agreement with the assigned value:	12
Questionable results:	11
Discrepant from the assigned value:	15
Missing results:	7

Thirty-two results were reported for the GH samples (see Figures 48A to 48D). Seventeen results are in agreement with the assigned value, while five results are questionable. Ten results are discrepant. The reported results show no significant bias.

Reported **GH** results:	32
In agreement with the assigned value:	17
Questionable results:	5
Discrepant from the assigned value:	10
Missing results:	7

3.4.4 Antimony-125

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

Forty-three results were reported for the GL samples (see Figures 39A to 39D). Thirty-five results are in agreement with the assigned value, while five results are questionable. Three results are discrepant. The reported results show no significant bias.

Reported **GL** results:	43
In agreement with the assigned value:	35
Questionable results:	5
Discrepant from the assigned value:	3
Missing results:	2

Thirty-six results were reported for the GH samples (see Figures 49A to 49D). Thirty-three results are in agreement with the assigned value, while two results are questionable. One result is discrepant. The reported results show no significant bias.

Reported **GH** results:	36
In agreement with the assigned value:	33
Questionable results:	2
Discrepant from the assigned value:	1
Missing results:	3

3.4.5 Barium-133

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

Forty-two results were reported for the GL samples (see Figures 40A to 40D). Thirty-three results are in agreement with the assigned value, while six results are questionable. Three results are discrepant. The reported results show a negative bias.

Reported **GL** results:	42
In agreement with the assigned value:	33
Questionable results:	6
Discrepant from the assigned value:	3
Missing results:	3

Thirty-six results were reported for the GH samples (see Figures 50A to 50D). Thirty results are in agreement with the assigned value, while four results are questionable. Two results are discrepant. The reported results show a negative bias.

Reported **GH** results:	36
In agreement with the assigned value:	30
Questionable results:	4
Discrepant from the assigned value:	2
Missing results:	3

3.4.6 Caesium-134

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

Forty-three results were reported for the GL samples (see Figures 41A to 41D). Thirty-five results are in agreement with the assigned value, while four results are questionable. Four results are discrepant. The reported results show no significant bias.

Reported **GL** results:	43
In agreement with the assigned value:	35
Questionable results:	4
Discrepant from the assigned value:	4
Missing results:	2

Thirty-seven results were reported for the GH samples (see Figures 51A to 51D). Thirty results are in agreement with the assigned value, while five results are questionable. Two results are discrepant. The reported results show a negative bias.

Reported **GH** results:	37
In agreement with the assigned value:	30
Questionable results:	5
Discrepant from the assigned value:	2
Missing results:	2

3.4.7 Caesium-137

There are no specific measurement problems for this nuclide.

Forty-five results were reported for the GL samples (see Figures 42A to 42D). Forty-one results are in agreement with the assigned value, while two results are questionable. Two results are discrepant. The reported results show no significant bias.

Reported **GL** results:	45
In agreement with the assigned value:	41
Questionable results:	2
Discrepant from the assigned value:	2
Missing results:	0

Thirty-nine results were reported for the GH samples (see Figures 52A to 52D). Thirty-one results are in agreement with the assigned value, while six results are questionable. Two results are discrepant. The reported results show no significant bias.

Reported **GH** results:	39
In agreement with the assigned value:	31
Questionable results:	6
Discrepant from the assigned value:	2
Missing results:	0

3.4.8 Cerium-144

There are no specific measurement problems for this nuclide.

Forty-one results were reported for the GL samples (see Figures 43A to 43D). Thirty-five results are in agreement with the assigned value, while four results are questionable. Two results are discrepant. The reported results show no significant bias.

Reported **GL** results:	41
In agreement with the assigned value:	35
Questionable results:	4
Discrepant from the assigned value:	2
Missing results:	4

Thirty-five results were reported for the GH samples (see Figures 53A to 53D). Thirty-three results are in agreement with the assigned value, while one result is questionable. One result is discrepant. The reported results show no significant bias.

Reported **GH** results:	35
In agreement with the assigned value:	33
Questionable results:	1
Discrepant from the assigned value:	1
Missing results:	4

3.4.9 Europium-152

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

Forty-three results were reported for the GL samples (see Figures 44A to 44D). Thirty results are in agreement with the assigned value, while five results are questionable. Eight results are discrepant. The reported results show a negative bias.

Reported **GL** results:	43
In agreement with the assigned value:	30
Questionable results:	5
Discrepant from the assigned value:	8
Missing results:	2

Thirty-six results were reported for the GH samples (see Figures 54A to 54D). Thirty results are in agreement with the assigned value, while four results are questionable. Two results are discrepant. The reported results show no significant bias.

Reported **GH** results:	36
In agreement with the assigned value:	30
Questionable results:	4
Discrepant from the assigned value:	2
Missing results:	3

3.4.10 Europium-155

The challenge in the measurement of this nuclide is the relative low energies of the two main gamma emissions (86.5 and 105.3 keV). This energy region contains (or is close) to the inflection point of the calibration curve, which may result in a relatively low accuracy and/or precision of the efficiency calibration, due to fitting problems. Additionally, there is potential inference from Pb-X rays (84.5 – 87.3 keV) and the possibility of mistaking this nuclide for ^{160}Tb or ^{109}Cd (which give rise to 86.8 and 88.0 keV peaks, respectively).

Forty-three results were reported for the GL samples (see Figures 45A to 45D). Thirty-six results are in agreement with the assigned value, while four results are questionable. Three results are discrepant. The reported results show no significant bias.

Reported **GL** results:	43
In agreement with the assigned value:	36
Questionable results:	4
Discrepant from the assigned value:	3
Missing results:	2

Thirty-four results were reported for the GH samples (see Figures 55A to 55D). Thirty-one results are in agreement with the assigned value, while two results are questionable. One result is discrepant. The reported results show no significant bias.

Reported **GH** results:	34
In agreement with the assigned value:	31
Questionable results:	2
Discrepant from the assigned value:	1
Missing results:	5

3.5 C samples

3.5.1 Hydrogen-3 (total)

The main difficulty in measuring the ^{3}H activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Nine results were reported for HTO (see Figure 56). All results are in agreement with the assigned value. All participants used combustion and conversion to H_2O to separate ^{3}H from the concrete matrix and the other nuclides. Lab 32 performed an additional distillation step. All participants used liquid scintillation counting as the detection method.

Reported results:	9
In agreement with the assigned value:	9
Questionable results:	0
Discrepant from the assigned value:	0

3.5.2 Hydrogen-3 (leachable)

The main difficulty in measuring the leachable ^{3}H activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Five results were reported for this nuclide (see Figure 57A). Four results are in agreement with the assigned value, while one result is discrepant. Most participants leached the concrete sample with water (except Lab 29 which heated the sample at 108 °C). All participants used liquid scintillation counting as the detection method.

Reported results:	5
In agreement with the assigned value:	4
Questionable results:	0
Discrepant from the assigned value:	1

3.5.3 Hydrogen-3 (fixed)

The main difficulty in measuring the fixed ^{3}H activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Two results were reported for this nuclide (see Figure 57B). Both results are in agreement with the assigned value. Both participants calculated the fixed ^{3}H activity concentration as the difference between total ^{3}H and leachable ^{3}H.

Reported results:	2
In agreement with the assigned value:	2
Questionable results:	0
Discrepant from the assigned value:	0

3.5.4 Carbon-14

The main difficulty in measuring the ^{14}C activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Five results were reported for this nuclide (see Figure 58). All results are in agreement with the assigned value. All participants used combustion and conversion to CO_2 to separate ^{14}C from the concrete matrix and the other nuclides. All participants used liquid scintillation counting as the detection method.

Reported results:	5
In agreement with the assigned value:	5
Questionable results:	0
Discrepant from the assigned value:	0

3.5.5 Potassium-40
There are no specific measurement problems for this nuclide.

Six results were reported for this nuclide (see Figure 59). All results are in agreement with the assigned value. All participants used gamma spectrometry as the detection method.

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

3.5.6 Calcium-41
The main difficulties in measuring the ^{41}Ca activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample and the fact that ^{41}Ca emits only low-energy X rays (3.3 – 3.6 keV) and Auger electrons (3.0 keV).

Three results were reported for this nuclide (see Figure 60). All results are in agreement with the assigned value. All participants used precipitation techniques (carbonate and oxalate) to separate ^{41}Ca from the concrete matrix and the other nuclides. All participants used liquid scintillation counting as the detection method.

Reported results:	3
In agreement with the assigned value:	3
Questionable results:	0
Discrepant from the assigned value:	0

3.5.7 Iron-55
The main difficulties 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).

Three results were reported for this nuclide (see Figure 61). All results are in agreement with the assigned value. Two participants used anion-exchange chromatography (Labs 34 and 38) to separate ^{55}Fe from the concrete matrix and the other nuclides, while Lab 32 used solvent extraction. All participants used liquid scintillation counting as the detection method.

Reported results:	3
In agreement with the assigned value:	3
Questionable results:	0
Discrepant from the assigned value:	0

3.5.8 Cobalt-60

There are no specific measurement problems for this nuclide.

Twenty-six results were reported for this nuclide (see Figures 62A to 62C). Nineteen results are in agreement with the assigned value, while five results are questionable. Two results are discrepant. All participants used gamma spectrometry as the detection method.

Reported results:	26
In agreement with the assigned value:	19
Questionable results:	5
Discrepant from the assigned value:	2

3.5.9 Nickel-63

The main difficulty in measuring the ^{63}Ni activity concentration is the need for a radiochemical separation from the other radionuclides present in the sample.

Three results were reported for this nuclide (see Figure 63). Two results are in agreement with the assigned value. One result is discrepant. All participants used DMG extraction chromatography to separate ^{63}Ni from the concrete matrix and the other nuclides. All participants used liquid scintillation counting as the detection method.

Reported results:	3
In agreement with the assigned value:	2
Questionable results:	0
Discrepant from the assigned value:	1

3.5.10 Barium-133

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

Twenty-four results were reported for this nuclide (see Figures 64A to 64C). Twenty results are in agreement with the assigned value, while two results are questionable. Two results are discrepant. All participants used gamma spectrometry as the detection method.

Reported results:	24
In agreement with the assigned value:	20
Questionable results:	2
Discrepant from the assigned value:	2

3.5.11 Cesium-137

There are no specific measurement problems for this nuclide.

Two results were reported for this nuclide (see Figure 65). Both results are in agreement with the assigned value. All participants used gamma spectrometry as the detection method. It is unclear whether ^{137}Cs, which is a fission product and not an activation product, was in fact present in the C samples. It is quite possible that the 662 keV single escape peak of ^{60}Co was interpretated as the 662 keV emission of ^{137}Cs (i.e., ^{137m}Ba). It was decided not to include the ^{137}Cs results in the final evaluation of the labs' results.

Reported results:	(2)
In agreement with the assigned value:	(2)
Questionable results:	(0)
Discrepant from the assigned value:	(0)

3.5.12 Europium-152

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

Twenty-five results were reported for this nuclide (see Figures 66A to 66C). Thirty-one results are in agreement with the assigned value, while one result is questionable. Three results are discrepant. All participants used gamma spectrometry as the detection method. The homogeneity tests (see Figures 70C and 70D) indicated that one of the samples which had been retained at NPL (sample ID X07050) contained significantly more ^{152}Eu and ^{154}Eu than the other thirteen retained samples, probably due to the presence of a hot-particle. As a result the uncertainty of the assigned value is dominated by the homogeneity uncertainty (see Appendix C9). The "questionable" result of Lab 66 cannot not be explained by the potential presence of another hot-particle in their sample (sample ID X07032), since their ^{154}Eu result was "in agreement" and close to the ^{154}Eu assigned value resulting in a ^{154}Eu / ^{152}Eu ratio of 3.1(3) which was lower than the robust mean [0.0395(9)]. It is assumed that ^{154}Eu / ^{152}Eu ratio is more or less constant throughout the sample and not affected by the concentration of stable Eu in the sample. The calculated value of the ^{154}Eu / ^{152}Eu ratio is within the range 0.034 – 0.043 and depends on the exact irradiation conditions and the nuclear data used. Lab 54 (sample ID X07052), whose ^{152}Eu result was "discrepant", did not report ^{154}Eu and had "discrepant" results for ^{60}Co and ^{133}Ba as well (although its ^{152}Eu GH result was very close to the ^{152}Eu GH assigned value). Finally, Lab 38 (sample ID X07040) had "discrepant" results for both ^{152}Eu and ^{154}Eu, but its ^{154}Eu / ^{152}Eu ratio [0.0502(23)] was significantly higher than the robust mean [0.0395(9)].

Reported results:	25
In agreement with the assigned value:	21
Questionable results:	1
Discrepant from the assigned value:	3

3.5.13 Europium-154

The challenge in the measurement of this nuclide is the need for coincidence summing corrections. Additionally, there is potential inference from ^{152}Eu emissions.

Twenty-one results were reported for this nuclide (see Figures 67A to 67C). Eighteen results are in agreement with the assigned value, while two results are questionable. One result is discrepant. All participants used gamma spectrometry as the detection method. The homogeneity tests (see Figures 70C and 70D) indicated that one of the samples which had been retained at NPL (sample ID X07050) contained significantly more ^{152}Eu and ^{154}Eu than the other thirteen retained samples, probably due to the presence of a hot-particle. As a result the uncertainty of the assigned value is dominated by the homogeneity uncertainty (see Appendix C9). The "questionable" result of Lab 32 cannot not be explained by the potential presence of another hot-particle in their sample (sample ID X07053), since their ^{152}Eu results were "in agreement" and close to the ^{152}Eu assigned value resulting in a ^{154}Eu / ^{152}Eu ratio of 0.053(9) which was higher than the robust mean [0.0395(9)]. It is assumed that ^{154}Eu / ^{152}Eu ratio is more or less constant throughout the sample and not affected by the concentration of stable Eu in the sample. The calculated value of the ^{154}Eu / ^{152}Eu ratio is within the range 0.034 – 0.043 and depends on the exact irradiation conditions and the nuclear data used. For a discussion on the "discrepant" ^{154}Eu result of Lab 38 see above (Section 3.5.12). Finally, the "discrepant" ^{154}Eu result of Lab 34 cannot not solely be explained by the potential presence of another hot-particle in their sample (sample ID X07035), since their ^{152}Eu result was "in agreement" and lower to the ^{152}Eu assigned value resulting in a ^{154}Eu / ^{152}Eu ratio of [0.13(4)] which was much higher than the robust mean [0.0395(9)].

Reported results:	21
In agreement with the assigned value:	18
Questionable results:	2
Discrepant from the assigned value:	1

3.5.14 Radium-226

There are no specific measurement problems for this nuclide.

Two results were reported for this nuclide (see Figure 68). Both results are in agreement with the assigned value. All participants used gamma spectrometry as the detection method.

Reported results:	2
In agreement with the assigned value:	2
Questionable results:	0
Discrepant from the assigned value:	0

3.5.15 Radium-228

There are no specific measurement problems for this nuclide.

Two results were reported for this nuclide (see Figure 69). Both results are in agreement with the assigned value. All participants used gamma spectrometry as the detection method.

Reported results:	2
In agreement with the assigned value:	2
Questionable results:	0
Discrepant from the assigned value:	0

3.6 Result summary

The combined results for all samples are listed in Tables 3.1 to 3.8. In total, 73% of the results were 'in agreement', 11% of the results were 'questionable', 12% of the results were 'discrepant' and 4% of the results were 'missing' [100% is represented by 1355 results].

Table 3.1 – Results AL

Nuclide	In agreement	Questionable	Discrepant
^{226}Ra	10 (67%)	2 (13%)	3 (20%)
^{237}Np	2 (50%)	0	2 (50%)
^{238}U	15 (71%)	3 (14%)	3 (14%)
^{238}Pu	18 (90%)	0	2 (10%)
^{239}Pu	18 (90%)	0	2 (10%)
^{241}Am	18 (86%)	1 (5%)	2 (10%)
^{244}Cm	8 (50%)	3 (19%)	5 (31%)
gross alpha	1 (20%)	2 (40%)	2 (40%)
Total	**90**	**11**	**21**
Total (%)	74	9	17

Table 3.2 – Results AH

Nuclide	In agreement	Questionable	Discrepant
^{226}Ra	8 (57%)	3 (21%)	3 (21%)
^{237}Np	6 (86%)	1 (14%)	0
^{238}U	13 (81%)	1 (6%)	2 (13%)
^{238}Pu	10 (77%)	3 (23%)	0
^{239}Pu	10 (77%)	3 (23%)	0
^{241}Am	13 (76%)	2 (12%)	2 (12%)
^{244}Cm	5 (38%)	3 (23%)	5 (38%)
gross alpha	2 (100%)	0	0
Total	**67**	**16**	**12**
Total (%)	71	17	13

Table 3.3 – Results BL

Nuclide	In agreement	Questionable	Discrepant
^{3}H	7 (47%)	1 (7%)	7 (47%)
^{55}Fe	2 (100%)	0	0
^{63}Ni	2 (50%)	1 (25%)	1 (25%)
^{89}Sr	4 (67%)	1 (17%)	1 (17%)
^{90}Sr	11 (69%)	4 (25%)	1 (6%)
^{99}Tc	6 (67%)	2 (22%)	1 (11%)
gross beta	3 (75%)	1 (25%)	0
Total	**35**	**10**	**11**
Total (%)	63	18	20

Table 3.4 – Results BH

Nuclide	In agreement	Questionable	Discrepant
^{3}H	11 (69%)	3 (19%)	2 (13%)
^{55}Fe	4 (57%)	1 (14%)	2 (29%)
^{63}Ni	3 (50%)	0	3 (50%)
^{89}Sr	4 (50%)	1 (13%)	3 (38%)
^{90}Sr	7 (47%)	2 (13%)	6 (40%)
^{99}Tc	5 (71%)	1 (14%)	1 (14%)
gross beta	1 (50%)	1 (50%)	0
Total	**35**	**9**	**17**
Total (%)	57	15	28

Table 3.5 – Results GL

Nuclide	In agreement	Questionable	Discrepant	Missing
^{60}Co	39 (87%)	3 (7%)	2 (4%)	1 (2%)
^{95}Zr	28 (62%)	10 (22%)	3 (7%)	4 (9%)
^{95}Nb	12 (27%)	11 (24%)	15 (33%)	7 (16%)
^{125}Sb	35 (78%)	5 (11%)	3 (7%)	2 (4%)
^{133}Ba	33 (73%)	6 (13%)	3 (7%)	3 (7%)
^{134}Cs	35 (78%)	4 (9%)	4 (9%)	2 (4%)
^{137}Cs	41 (91%)	2 (4%)	2 (4%)	0
^{144}Ce	35 (78%)	4 (9%)	2 (4%)	4 (9%)
^{152}Eu	30 (67%)	5 (11%)	8 (18%)	2 (4%)
^{155}Eu	36 (80%)	4 (9%)	3 (7%)	2 (4%)
Total	**324**	**54**	**45**	**27**
Total (%)	72	12	10	6

Table 3.6 – Results GH

Nuclide	In agreement	Questionable	Discrepant	Missing
^{60}Co	33 (85%)	4 (10%)	1 (3%)	1 (3%)
^{95}Zr	29 (74%)	2 (5%)	4 (10%)	4 (10%)
^{95}Nb	17 (44%)	5 (13%)	10 (26%)	7 (18%)
^{125}Sb	33 (85%)	2 (5%)	1 (3%)	3 (8%)
^{133}Ba	30 (77%)	4 (10%)	2 (5%)	3 (8%)
^{134}Cs	30 (77%)	5 (13%)	2 (5%)	2 (5%)
^{137}Cs	31 (79%)	6 (15%)	2 (5%)	0
^{144}Ce	33 (85%)	1 (3%)	1 (3%)	4 (10%)
^{152}Eu	30 (77%)	4 (10%)	2 (5%)	3 (8%)
^{155}Eu	31 (79%)	2 (5%)	1 (3%)	5 (13%)
Total	**297**	**35**	**26**	**32**
Total (%)	76	9	7	8

Table 3.7 – Results B2

Nuclide	In agreement	Questionable	Discrepant
^{3}H (aqueous)	0	2 (14%)	12 (86%)
^{3}H corrected*	9 (64%)	1(7%)	4(29%)
^{3}H (OBT)	0	1 (33%)	2 (67%)
^{14}C	4 (31%)	1 (8%)	8 (62%)
^{36}Cl	4 (80%)	0	1 (20%)
^{129}I	8 (73%)	0	3 (27%)
Total	**16**	**4**	**26**
Total (%)	35	9	57
Total *	**25**	**2**	**16**
Total (%) *	58	5	37

Table 3.8 – Results C

Nuclide	In agreement	Questionable	Discrepant
^{3}H total	9 (100%)	0	0
^{3}H leachable	4 (80%)	0	1 (20%)
^{3}H fixed	2 (100%)	0	0
^{14}C	5 (100%)	0	0
^{40}K	6 (100%)	0	0
^{41}Ca	3 (100%)	0	0
^{55}Fe	3 (100%)	0	0
^{60}Co	19 (73%)	5 (19%)	2 (8%)
^{63}Ni	2 (67%)	0	1 (33%)
^{133}Ba	20 (83%)	2 (8%)	2 (8%)
(^{137}Cs)	(2) (100%)	(0)	(0)
^{152}Eu	21 (84%)	1 (4%)	3 (12%)
^{154}Eu	18 (86%)	2 (10%)	1 (5%)
^{226}Ra	2 (100%)	0	0
^{228}Ra	2 (100%)	0	0
Total	**116**	**10**	**10**
Total (%)	85	7	7

3.7 False positive identifications

Table 3.9 – False positive identifications

Nuclide	Number of participants	Potential cause
^{40}K (GL)	3	Background
^{59}Fe (GL)	1	Mistaken for ^{152}Eu
^{109}Cd (GL)	1	Mistaken for ^{155}Eu
^{22}Na (GH)	2	Unknown
^{51}Cr (GH)	3	Mistaken for ^{125}Sb
^{58}Co (GH)	2	Mistaken for ^{152}Eu
^{58}Co (C)	3	Mistaken for ^{152}Eu
^{109}Cd (GH)	1	Mistaken for ^{155}Eu
^{65}Zn (GH)	1	Unknown
^{125}I (GH)	1	Mistaken for ^{125}Sb

Americium-241 (which was reported by three participants) was present as an impurity [i.e., 0.622(25) Bq kg^{-1} in the GL samples and 0.315(13) Bq g^{-1} in the GH samples]. Only a negligible activity of ^{154}Eu was present as an impurity [i.e., 0.052(8) Bq kg^{-1} in the GL samples and 0.055(9) Bq g^{-1} in the GH samples].

3.8 Analysis of results by participant

The combined results for each participant are presented in Tables 3.10 and 3.11. The individual deviation results are presented in Figures 71 to 135.

Table 3.10 – Individual results (excluding concrete C samples)

Participant	Results in agreement	Questionable results	Discrepant results	Missing results
3	4 (67%)	0	2 (33%)	0
4	8 (31%)	2 (8%)	0	16 (62%)
5	21 (81%)	2 (8%)	3 (12%)	0
7	22 (85%)	1 (4%)	3 (12%)	0
8	34 (76%)	6 (13%)	5 (11%)	0
9	9 (90%)	0	1 (10%)	0
13	26 (90%)	2 (7%)	1 (3%)	0
14	12 (71%)	4 (24%)	1 (6%)	0
15	16 (80%)	3 (15%)	1 (5%)	0
16	10 (83%)	0	1 (8%)	1 (8%)
17	12 (55%)	5 (23%)	5 (23%)	0
18	10 (100%)	0	0	0
19	10 (91%)	1 (9%)	0	0
21	25 (86%)	2 (7%)	2 (7%)	0
22	31 (91%)	1 (3%)	2 (6%)	0
23	9 (90%)	0	1 (10%)	0
25	27 (82%)	1 (3%)	5 (15%)	0
26	12 (80%)	0	3 (20%)	0
27	12 (60%)	7 (35%)	1 (5%)	0
28	33 (85%)	3 (8%)	3 (8%)	0
29	5 (33%)	0	10 (67%)	0
30	9 (53%)	3 (18%)	5 (29%)	0
32	25 (93%)	1 (4%)	0	1 (4%)
34	20 (80%)	3 (12%)	2 (8%)	0
35	23 (62%)	5 (14%)	9 (24%)	0
38	21 (75%)	2 (7%)	4 (14%)	1 (4%)
39	11 (92%)	0	1 (8%)	0
40	6 (25%)	8 (33%)	10 (42%)	0
41	9 (56%)	6 (38%)	1 (6%)	0
42	12 (86%)	1 (7%)	1 (7%)	0
45	9 (90%)	1 (10%)	0	0
46	22 (96%)	0	1 (4%)	0
47	31 (86%)	4 (11%)	1 (3%)	0
48	5 (50%)	2 (20%)	3 (30%)	0

continues

continued

Participant	Results in agreement	Questionable results	Discrepant results	Missing results
52	20 (100%)	0	0	0
53	21 (100%)	0	0	0
54	16 (80%)	0	0	4 (20%)
55	20 (80%)	3 (12%)	2 (8%)	0
56	1 (8%)	1 (8%)	10 (83%)	0
58	1 (10%)	9 (90%)	0	0
59	10 (100%)	0	0	0
61	8 (40%)	5 (25%)	4 (20%)	3 (15%)
62	10 (100%)	0	0	0
65	15 (88%)	0	2 (12%)	0
66	8 (22%)	8 (22%)	18 (49%)	3 (8%)
67	9 (90%)	0	1 (10%)	0
68	17 (81%)	2 (10%)	0	2 (10%)
69	1 (100%)	0	0	0
71	4 (80%)	0	1 (20%)	0
72	9 (82%)	1 (9%)	1 (9%)	0
73	32 (84%)	4 (11%)	2 (5%)	0
74	5 (31%)	2 (13%)	2 (13%)	7 (44%)
75	15 (83%)	1 (6%)	2 (11%)	0
76	9 (75%)	0	2 (17%)	1 (8%)
77	9 (90%)	1 (10%)	0	0
78	2 (33%)	1 (17%)	3 (50%)	0
79	9 (90%)	1 (10%)	0	0
80	6 (60%)	4 (40%)	0	0
81	10 (91%)	1 (9%)	0	0
82	17 (85%)	3 (15%)	0	0
83	2 (10%)	0	0	18 (90%)
84	3 (30%)	7 (70%)	0	0
85	5 (42%)	2 (17%)	3 (25%)	2 (17%)
86	16 (80%)	0	4 (20%)	0
87	13 (65%)	4 (20%)	3 (15%)	0
Total	**875 (72%)**	**135 (11%)**	**148 (12%)**	**59 (5%)**

Table 3.11 – Individual results concrete C samples

Participant	Results in agreement	Questionable results	Discrepant results	False positives
3	5 (83%)	0	0	1 (17%)
4	2 (67%)	1 (33%)	0	0
5	8 (100%)	0	0	0
8	4 (100%)	0	0	0
17	6 (100%)	0	0	0
18	4 (100%)	0	0	0
21	4 (80%)	0	0	1 (20%)
28	4 (100%)	0	0	0
29	6 (100%)	0	0	0
30	6 (100%)	0	0	0
32	9 (82%)	1 (9%)	1 (9%)	0
34	8 (89%)	1 (11%)	0	0
35	5 (100%)	0	0	0
38	5 (63%)	0	3 (38%)	0
40	5 (83%)	0	1 (17%)	0
48	0	0	2 (100%)	0
52	4 (100%)	0	0	0
53	4 (100%)	0	0	0
54	0	0	3 (100%)	0
56	2 (67%)	1 (33%)	0	0
58	5 (71%)	2 (29%)	0	0
66	2 (33%)	3 (50%)	0	1 (17%)
74	1 (100%)	0	0	0
81	4 (100%)	0	0	0
84	3 (75%)	1 (25%)	0	0
85	5 (100%)	0	0	0
86	5 (100%)	0	0	0
Total	**116 (83%)**	**10 (7%)**	**10 (7%)**	**3 (2%)**

3.9 Results UK / non-UK and 2005 / 2007 participants

The following table compares the results of UK participants with the non-UK participants for the aqueous samples in the 2005 and 2007 Exercises (excluding the C sample results).

Table 3.12 – Results UK/non-UK and 2005/2007 participants

Participant sector	Results in agreement (%)	Number of results
UK participants in 2005	70	576 (64%)
UK participants in 2007	74	677 (56%)
non-UK participants in 2005	75	322 (36%)
non-UK participants in 2007	69	540 (44%)
2007 participants in 2005	71	762 (85%)
2005 participants in 2007	75	835 (69%)
non-2007 participants in 2005	80	136 (15%)
non-2005 participants in 2007	65	382 (31%)
Total 2005	**72**	**898**
Total 2007	**72**	**1217**

The following conclusions can be drawn from this table:

(i) The overall performance for the 2005 and 2007 Exercises was the same.
(ii) The performance of the UK participants, which was slightly below the overall performance in 2005, was slightly above the overall performance in 2007.
(iii) Consequently, the performance of the non-UK participants, which was slightly above the overall performance in 2005, was slightly below the overall performance in 2007.
(iv) The performance of the participants who participated in both Exercises was slightly better in 2007 than in 2005.
(v) The performance of the participants who participated only in one Exercise was better in 2005 than in 2007.

3.10 Robust mean values participants

The robust means for the participants' results were calculated and compared with the assigned values (except for the nuclides in the C samples where the robust means are equal to the assigned values).

The robust means for the participants' results for ^{244}Cm (AH), ^{55}Fe (BH), ^{133}Ba (GL and GH), ^{134}Cs (GH) and ^{152}Eu (GL) were significantly lower than assigned value, while the robust means for the participants' results for ^{3}H HTO (B2) and ^{95}Nb (GL) were significantly higher than assigned value.

Table 3.13 – Robust mean values participants

Nuclide	Assigned value *N*	Robust mean	Zeta test	Critical value
	Bq kg^{-1}	Bq kg^{-1}		
^{226}Ra **(AL)**	9.99(13)	10.0(3)	0.02	2.85
^{237}Np	8.60(9)	9(3)	-0.02	5.84
^{238}U	3.72(9)	3.64(8)	-0.67	2.63
^{238}Pu	17.13(8)	17.29(20)	0.79	2.79
^{239}Pu	19.59(12)	19.59(17)	-0.03	2.70
^{241}Am	10.07(4)	10.27(20)	1.01	2.83
^{244}Cm	13.20(6)	12.0(6)	-2.09	2.95
gross alpha	93(17)	7(3) × 10^{1}	-0.79	3.50
	Bq g^{-1}	Bq g^{-1}		
^{226}Ra **(AH)**	4.84(7)	4.90(25)	0.22	2.98
^{237}Np	16.63(17)	17.6(6)	1.64	3.50
^{238}U	2.02(5)	1.93(5)	-1.36	2.68
^{238}Pu	16.93(5)	16.9(5)	-0.10	3.11
^{239}Pu	7.91(4)	7.76(16)	-0.94	3.05
^{241}Am	3.858(8)	3.89(9)	0.37	2.92
^{244}Cm	17.23(6)	15.4(5)	-3.55 D	3.05
gross alpha	75(8)	73.2(23)	-0.16	2.60
	Bq kg^{-1}	Bq kg^{-1}		
^{3}H **(BL)**	8.15(6)	11.1(13)	2.33	2.98
^{55}Fe	10.42(18)	11.3(8)	1.04	63.66
^{63}Ni	8.6(4)	8.4(19)	-0.09	5.84
^{89}Sr	15.90(10)	15(3)	-0.30	4.03
^{90}Sr	13.37(3)	13.0(6)	-0.64	2.95
^{99}Tc	16.45(4)	16.1(9)	-0.36	3.36
gross beta	43(10)	42.5(19)	-0.01	2.58
		continues		

continued				
Nuclide	**Assigned value *N***	**Robust mean**	**Zeta test**	**Critical value**
	Bq g^{-1}	Bq g^{-1}		
^{3}H **(BH)**	2.727(19)	2.80(5)	1.73	2.83
^{55}Fe	5.55(10)	5.01(10)	-3.82 D	2.86
^{63}Ni	9.8(4)	10.7(13)	0.68	4.03
^{89}Sr	6.67(4)	8.1(8)	1.82	3.50
^{90}Sr	17.06(3)	16.5(8)	-0.67	2.98
^{99}Tc	6.501(15)	6.11(14)	-2.77	3.71
gross beta	41(4)	41(7)	0.09	63.66
	Bq kg^{-1}	Bq kg^{-1}		
^{3}H HTO **(B2)**	*426(4)*	*572(21)*	*6.95 D*	*2.98*
3H (total)*	637(5)	572(21)	-3.08 D	2.98
^{3}H OBT	*211(3)*	*4(3) × 10^{2}*	*0.88*	*9.92*
^{14}C	176.4(11)	132(19)	-2.34	3.05
^{36}Cl	402.2(25)	381(19)	-1.07	4.60
^{129}I	372(4)	389(15)	1.13	3.11
	Bq kg^{-1}	Bq kg^{-1}		
^{60}Co **(GL)**	11.72(4)	11.69(11)	-0.29	2.67
^{95}Zr	4.21(5)	4.35(10)	1.22	2.66
^{95}Nb	7.38(10)	9.2(6)	3.11 D	2.70
^{125}Sb	13.45(7)	13.36(16)	-0.57	2.66
^{133}Ba	4.15(3)	3.94(8)	-2.69 D	2.67
^{134}Cs	3.95(3)	3.79(7)	-2.08	2.67
^{137}Cs	8.84(6)	8.94(6)	1.23	2.60
^{144}Ce	14.80(10)	14.94(17)	0.68	2.64
^{152}Eu	17.91(12)	16.75(12)	-3.34 D	2.67
^{155}Eu	6.18(5)	6.28(12)	0.82	2.67
	Bq g^{-1}	Bq g^{-1}		
^{60}Co **(GH)**	16.32(5)	16.26(10)	-0.55	2.66
^{95}Zr	6.82(8)	6.87(8)	0.50	2.61
^{95}Nb	11.94(16)	12.3(3)	0.92	2.67
^{125}Sb	17.24(8)	17.07(13)	-1.12	2.65
^{133}Ba	4.07(3)	3.92(4)	-3.07 D	2.64
^{134}Cs	1.127(8)	1.080(15)	-2.82 D	2.66
continues				

continued				
Nuclide	**Assigned value *N***	**Robust mean**	**Zeta test**	**Critical value**
	Bq g^{-1}	Bq g^{-1}		
^{137}Cs **(GH)**	3.68(3)	3.73(4)	1.21	2.63
^{144}Ce	7.50(6)	7.52(7)	0.21	2.62
^{152}Eu	18.99(14)	18.44(16)	-2.62	2.62
^{155}Eu	3.72(3)	3.79(5)	1.21	2.66
	Bq g^{-1}	Bq g^{-1}		
^{3}H total **(C)**	8.9(15)	8.9(15)	–	–
^{3}H leachable	1.3(8)	1.3(8)	–	–
^{3}H fixed	7.8(23)	7.8(18)	–	–
^{14}C	0.18(10)	0.18(10)	–	–
^{40}K	0.20(4)	0.20(4)	–	–
^{41}Ca	0.41(15)	0.41(15)	–	–
^{55}Fe	0.037(14)	0.037(14)	–	–
^{60}Co	0.0754(19)	0.0754(19)	–	–
^{63}Ni	0.0177(24)	0.0177(24)	–	–
^{133}Ba	0.055(3)	0.055(3)	–	–
(^{137}Cs)	0.00110(23)	0.00110(18)	–	–
^{152}Eu	1.17(13)	1.17(13)	–	–
^{154}Eu	0.048(5)	0.048(5)	–	–
^{226}Ra	0.05020(19)	0.05020(14)	–	–
^{228}Ra	0.0102(23)	0.0102(17)	–	–

3.11 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 3.14 and plotted Figures 136 and 137. For the aqueous samples, R_{med} was used to calculate the standard uncertainty for proficiency assessment σ_p and the *z*-score for each result (except when the data set was smaller than 10, in which case any R_{med} > 20% was set at 20% and any R_{med} < 5% was set at 5%). R_{med} values ranged from to 4% to 17%, but in general were of the order of 6%. The IQR outlier test (see Table H1; Appendix H) was used to determine whether a relative uncertainty was significantly different from the other results in the data set, resulting in the exclusion of thirteen relative uncertainty results (1% of the total results). For eight 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 five 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 13% to 41%.

Table 3.14 – Relative uncertainties of the lab values

Nuclide	Number of results	Median relative uncertainty R_{med} (%)	Number of outliers	Outlier limit R_{lim} (%)
^{226}Ra (AL)	14	7.1	1	34
^{237}Np	4	15	–	–
^{238}U	21	6.3	0	20
^{238}Pu	20	5.6	0	25
^{239}Pu	20	5.1	0	23
^{241}Am	21	5.6	1	20
^{244}Cm	16	5.9	0	25
gross alpha	5	5.3	–	–
^{226}Ra (AH)	14	6.1	1	30
^{237}Np	7	7.4	0	33
^{238}U	16	4.9	0	26
^{238}Pu	12	5.2	0	21
^{239}Pu	12	5.3	0	26
^{241}Am	17	4.2	0	17
^{244}Cm	13	5.1	0	21
gross alpha	2	3.4#	–	–
^{3}H (BL)	15	12	0	41
^{55}Fe	2	15	–	–
^{63}Ni	4	11	–	–
^{89}Sr	6	17	–	–
continues				

continued

Nuclide	Number of results	Median relative uncertainty R_{med} (%)	Number of outliers	Outlier limit R_{lim} (%)
^{90}Sr	16	7.6	0	35
^{99}Tc	9	9.9	0	23
gross beta	4	7.2	–	–
^{3}H (BH)	16	4.9	0	31
^{55}Fe	7	7.6	0	24
^{63}Ni	6	5.0	–	–
^{89}Sr	8	11	0	36
^{90}Sr	15	4.2	1	22
^{99}Tc	7	6.9	0	29
gross beta	2	1.8#	–	–
^{60}Co (GL)	45	5.4	0	29
^{95}Zr	41	9.8	1	40
^{95}Nb	39	6.8	2	31
^{125}Sb	43	6.2	1	24
^{133}Ba	42	6.6	0	27
^{134}Cs	43	6.9	0	27
^{137}Cs	45	6.0	1	27
^{144}Ce	41	7.1	0	34
^{152}Eu	42	5.6	1	21
^{155}Eu	43	7.9	0	35
^{60}Co (GH)	39	4.0	1	16
^{95}Zr	35	4.0	0	15
^{95}Nb	33	5.3	1	20
^{125}Sb	36	4.3	0	14
^{133}Ba	36	4.5	0	16
^{134}Cs	37	4.4	0	17
^{137}Cs	39	3.9	1	15
^{144}Ce	35	4.9	0	17
^{152}Eu	36	4.6	0	17
^{155}Eu	34	4.9	0	13
^{3}H HTO (B2)	14	6.8	0	28
^{3}H OBT	3	15	–	–
^{14}C	13	8.3	0	34

continues

continued				
Nuclide	**Number of results**	**Median relative uncertainty R_{med} (%)**	**Number of outliers**	**Outlier limit R_{lim} (%)**
^{36}Cl	5	6.8	–	–
^{129}I	11	4.4	0	25
^{3}H total (C)	9	12	0	36
^{3}H leach	5	8.9	–	–
^{3}H fixed	2	14	–	–
^{14}C	5	15	–	–
^{40}K	6	7.7	–	–
^{41}Ca	3	18	–	–
^{55}Fe	3	22	–	–
^{60}Co	26	5.3	1	29
^{63}Ni	3	17	–	–
^{133}Ba	24	6.1	0	20
(^{137}Cs)	2	26	–	–
^{152}Eu	25	5.0	0	26
^{154}Eu	21	8.2	0	23
^{226}Ra	2	62	–	–
^{228}Ra	2	8.9	–	–

Set at a value of 5.0%

4. CONCLUSION

The 2007 proficiency test exercise was successfully completed, with all but one of the laboratories returning data. In total, 212 samples were shipped to 66 participants and 1355 results were submitted. All 65 data sets were submitted electronically. In total, 73% of the results were 'in agreement', 11% of the results were 'questionable', 12% of the results were 'discrepant' and 4% of the results were 'missing' [100% is represented by 1355 results]. The overall level of performance was similar to that observed in the previous Exercise (2005). The performance of the participants who participated in both Exercises was slightly better in 2007 than in 2005. The performance of the new participants was worse than the established participants. For the aqueous samples, 40 participants scored 80% or higher 'in agreement' results, while 18 participants scored 90% or higher 'in agreement' results.

For the AL and AH samples, 74% and 71%, respectively, of the results were 'in agreement'. In both cases, the most problematic nuclide was ^{244}Cm. For the BL and BH samples, 63% and 57%, respectively, of the results were 'in agreement'. For the BL samples, the most problematic nuclides was ^{3}H, while for the BH samples, the most problematic nuclides were ^{63}Ni, ^{89}Sr and ^{90}Sr.

Most participants were able to identify all the nuclides in the GL and GH samples. The number of 'false positives' results was 18. More than one false positive result was returned for ^{22}Na, ^{40}K, ^{51}Cr and ^{58}Co (reported by 2, 3, 3 and 3 participants, respectively). For the GL and GH samples, 72% and 76% of the results were 'in agreement'. For the GL samples, the most problematic nuclides were ^{95}Zr, ^{95}Nb and ^{152}Eu, while for the GH samples, the most problematic nuclides was ^{95}Nb. There was a significant negative bias between the assigned result and the participants results for ^{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., ^{60}Co, ^{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 GL and GH results for ^{95}Nb were 'in agreement', with a third of the GL deviations exceeding 40%. It is clear that the use of incorrect decay corrections was the reason for this disappointing result.

For the B2 samples, 58% of the results were 'in agreement'. The most problematic nuclides were ^{3}H (both HTO and OBT) and ^{14}C. Initially, none of 17 returned results (14 for HTO and 3 for OBT) were "in agreement". It was decided to re-evaluate the results against the total tritium activity concentration, since it was likely that OBT decomposition had occurred. This re-evaluation resulted in 9 results "in agreement" for HTO, while the 3 OBT results were excluded from the exercise.

Finally, 85% of the results for the solid C samples were 'in agreement'. The data treatment for these samples was different, because the assigned values were derived from the consensus values (making this a comparison rather than a proficiency test), while the corresponding uncertainties were derived from the uncertainty of the consensus value and the homogeneity uncertainty.

5. FIGURES

Figures 1 to 55

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 2.576 times the assigned value uncertainty u_N. Thus, a laboratory value $L = N + 2.576\ u_N$ results in a deviation $D = 100\ (2.576\ u_N / N)$ %; the corresponding zeta score is ≤ 2.576 by definition. The light blue lines represent z-scores of –2.576 and 2.576.

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 median is represented by the dark blue bar. 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.

Figures 56 to 69

A Participants' results L '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_L (with a coverage factor of k=1). The black dotted lines represent acceptable z-scores.

Figures 62, 64, 66 and 67

B 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 median is represented by the dark blue bar. The dotted line represents the outlier limit R_{lim}.

C 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 70	Homogeneity tests for ^{60}Co (A), ^{133}Ba (B), ^{152}Eu (C) and ^{154}Eu (D)
Figures 71 to 135	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 136	The medians of the relative uncertainties of the laboratory values R_{med} are represented by the light blue bars.
Figure 137	The outlier limits for the relative uncertainties R_{lim} are represented by the light blue bars.
Figure 138	Normalised ^{244}Cm / ^{241}Am ratios AL (A) and AH (B). The values significantly different from unity are represented by the red points.

Figure 1A – Deviation Ra-226 AL

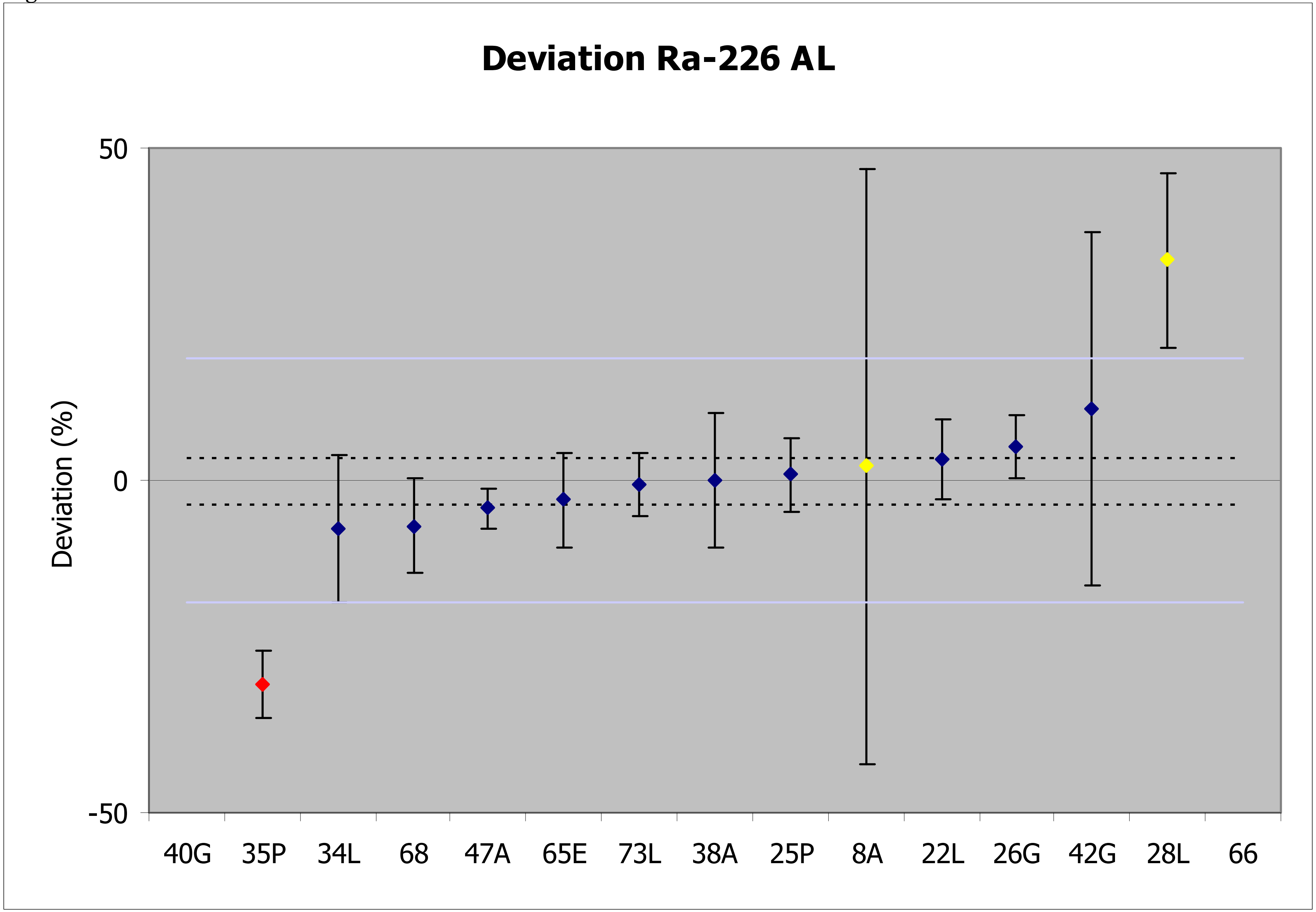


Figure 1B – Zeta score Ra-226 AL

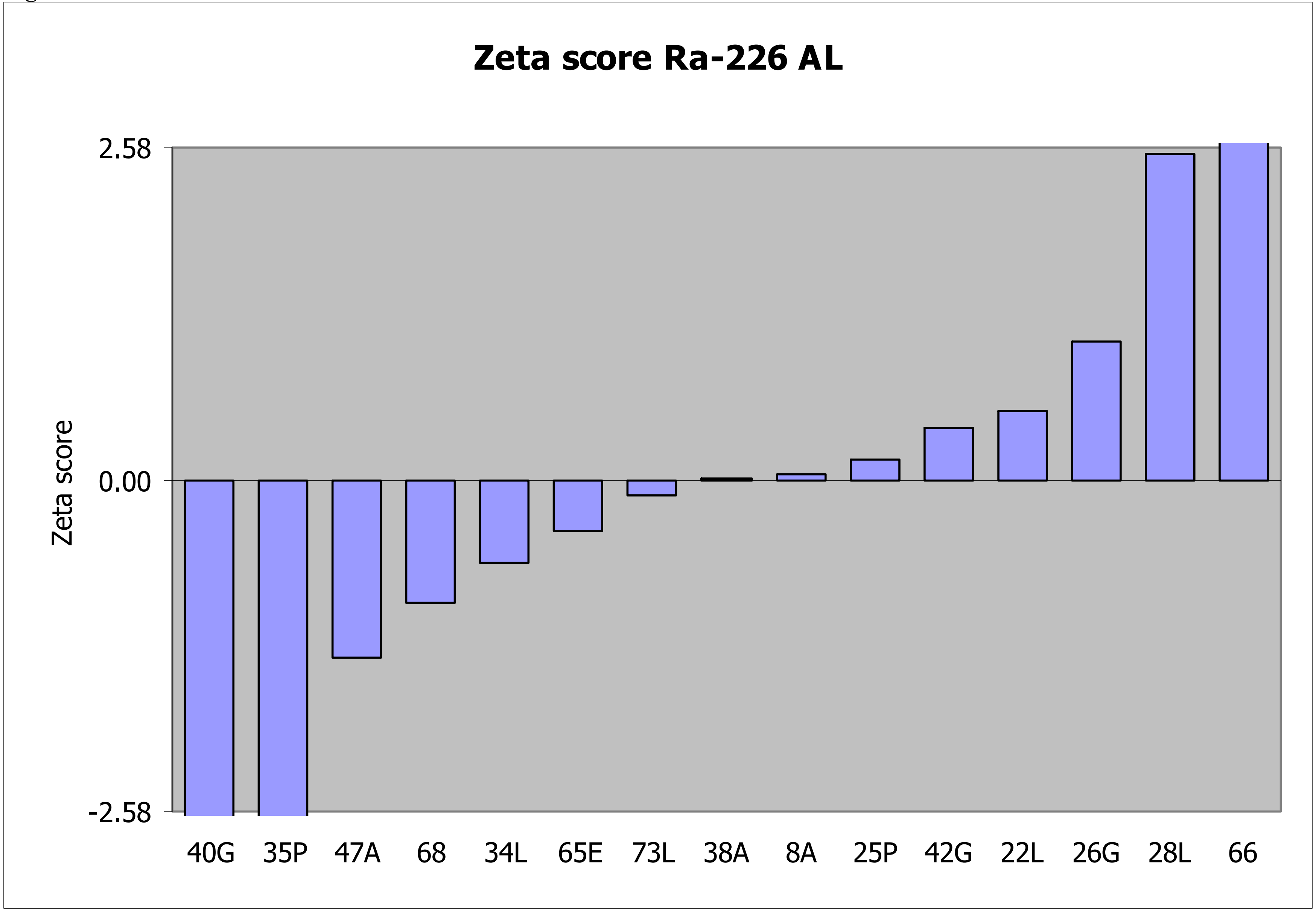


Figure 1C – Relative uncertainty Ra-226 AL

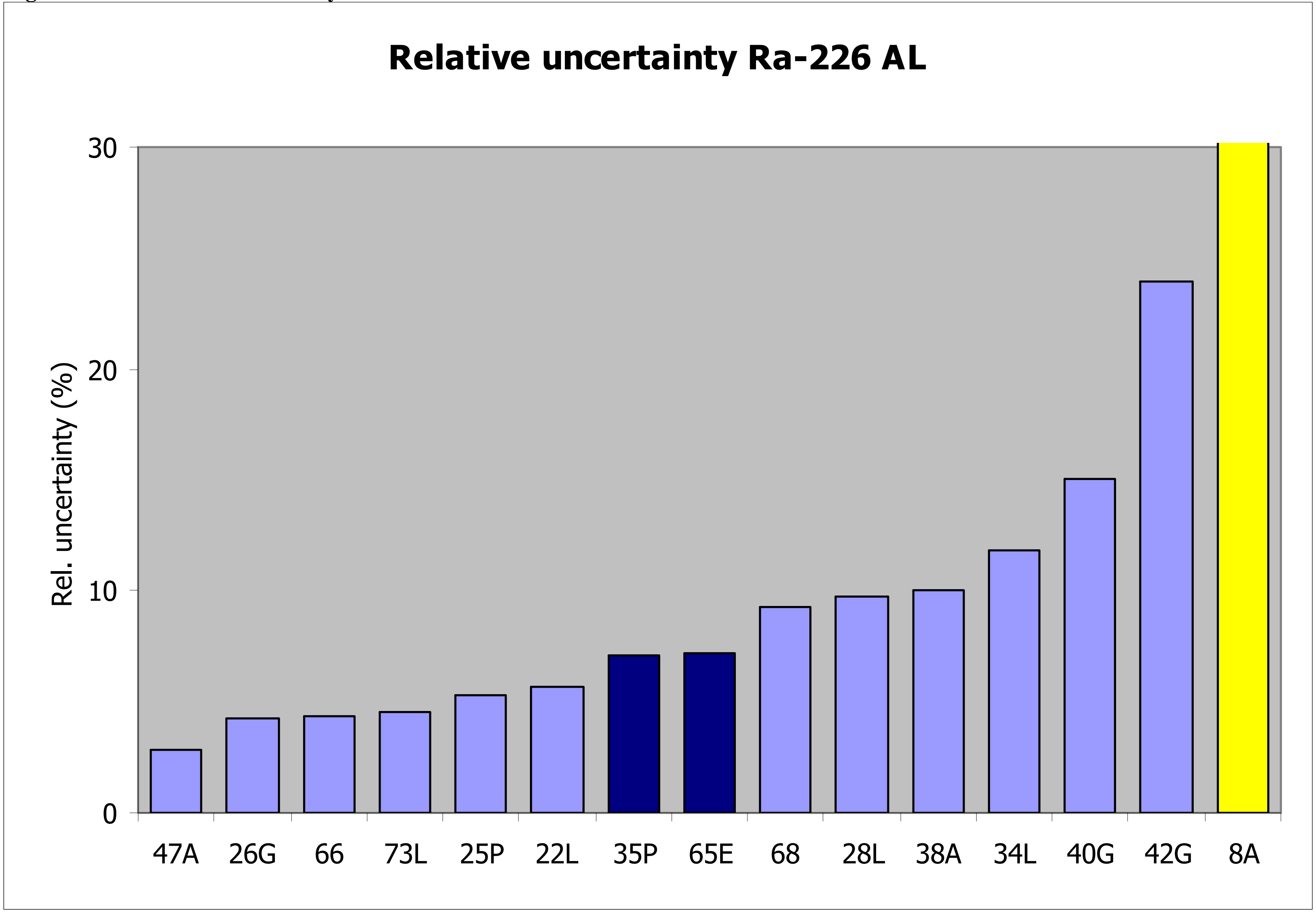


Figure 1D – Kiri plot Ra-226 AL

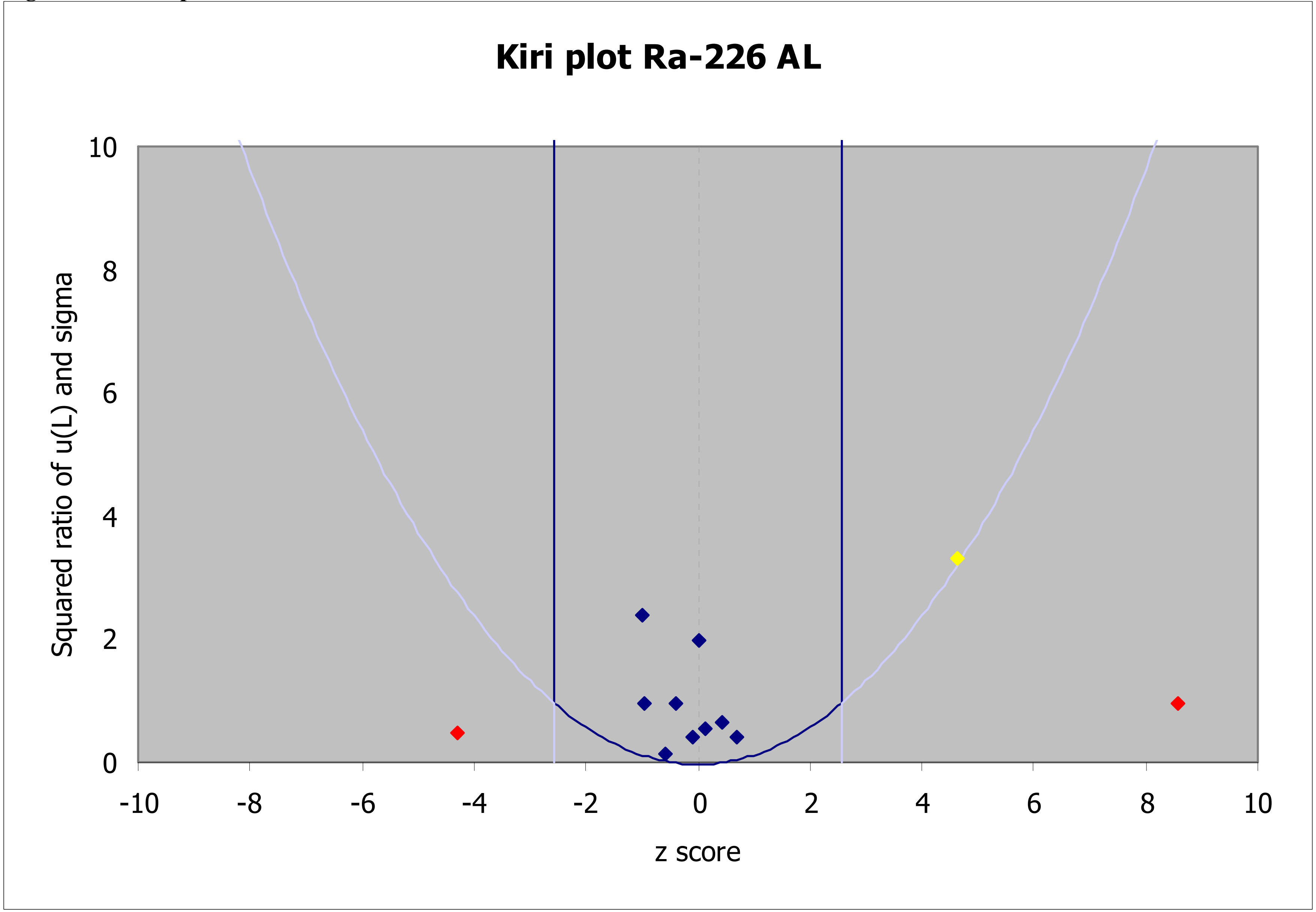


Figure 2A – Deviation Np-237 AL

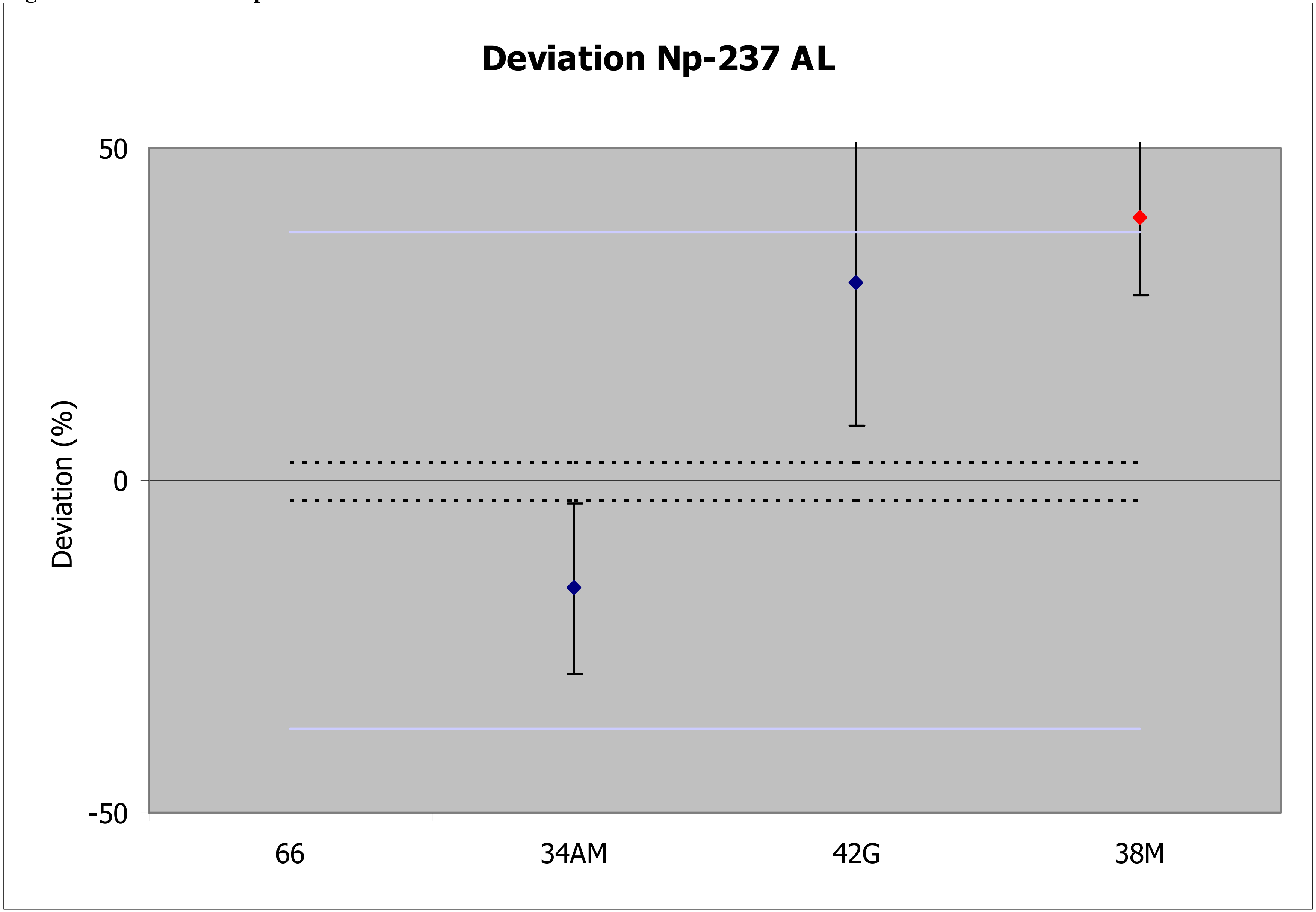


Figure 2B – Zeta score Np-237 AL

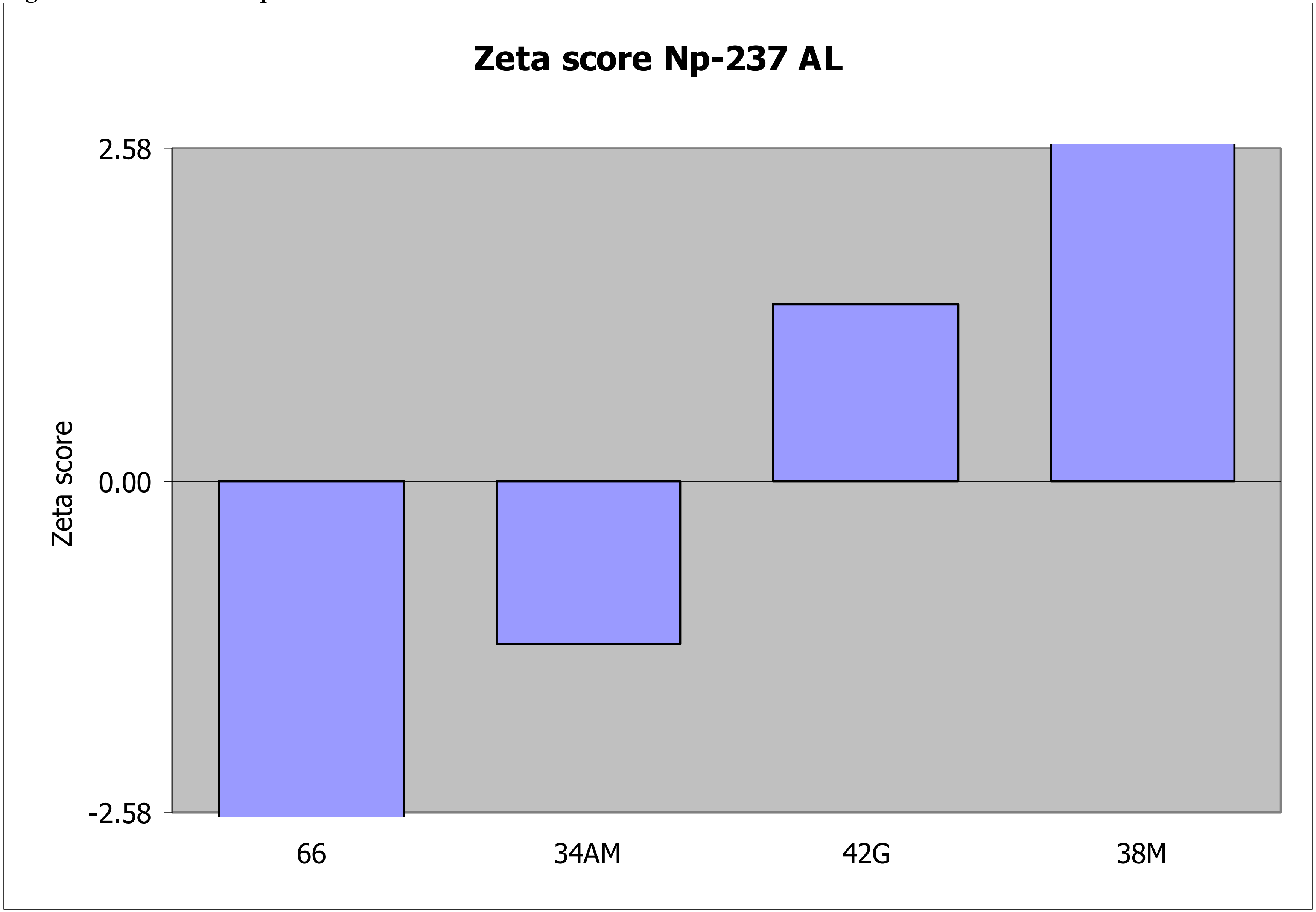


Figure 2C – Relative uncertainty Np-237 AL

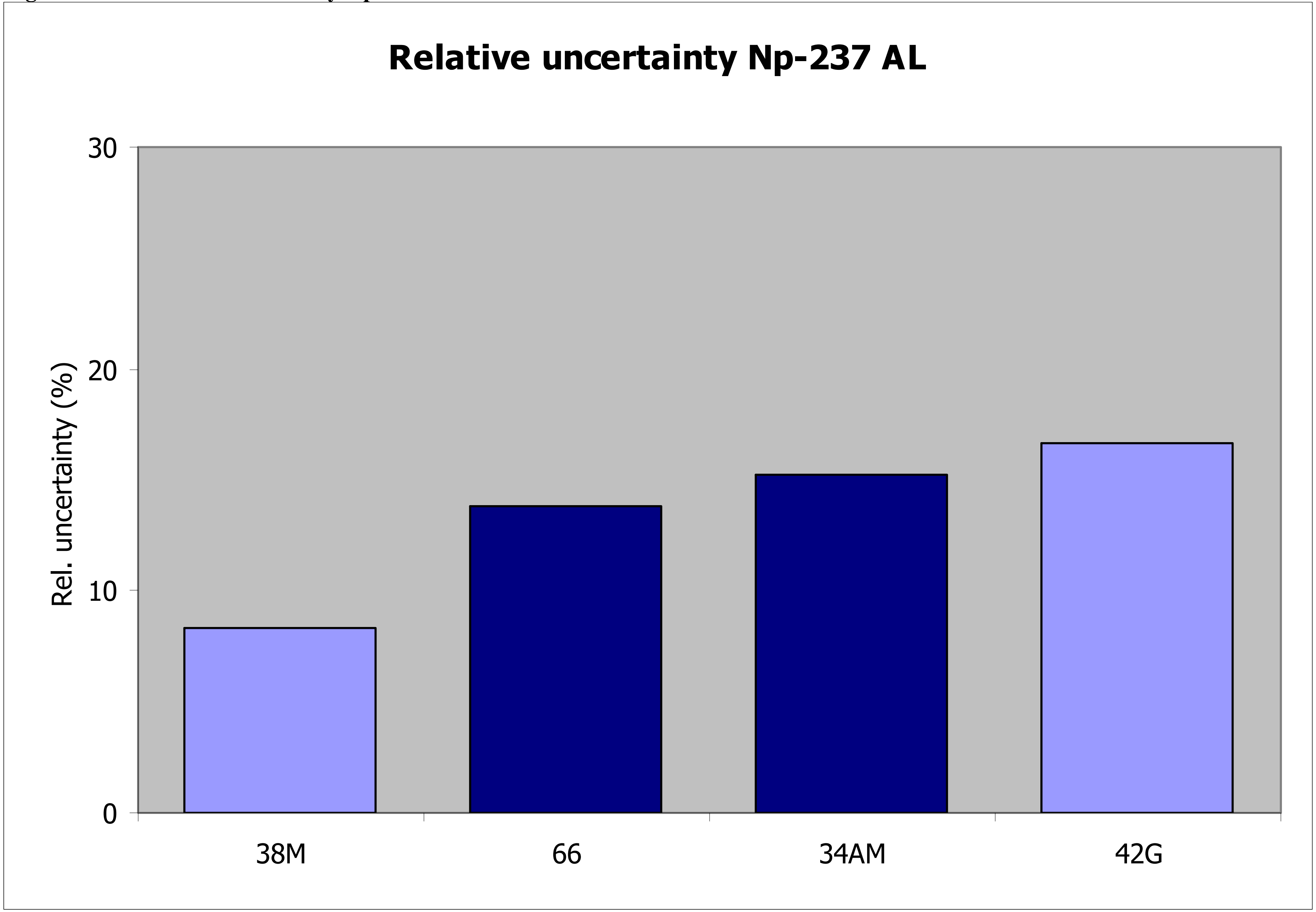


Figure 2D – Kiri plot Np-237 AL

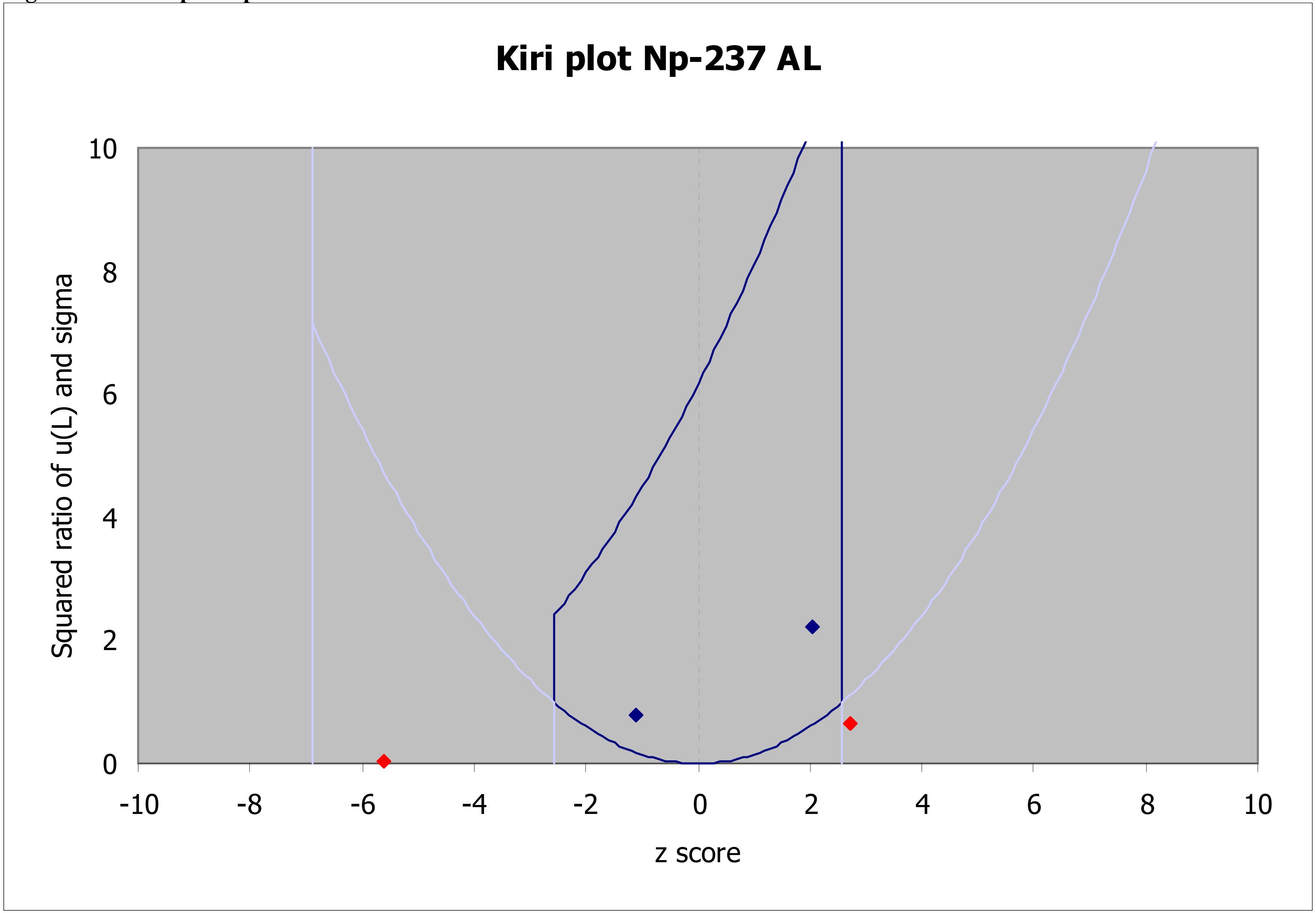


Figure 3A – Deviation U-238 AL

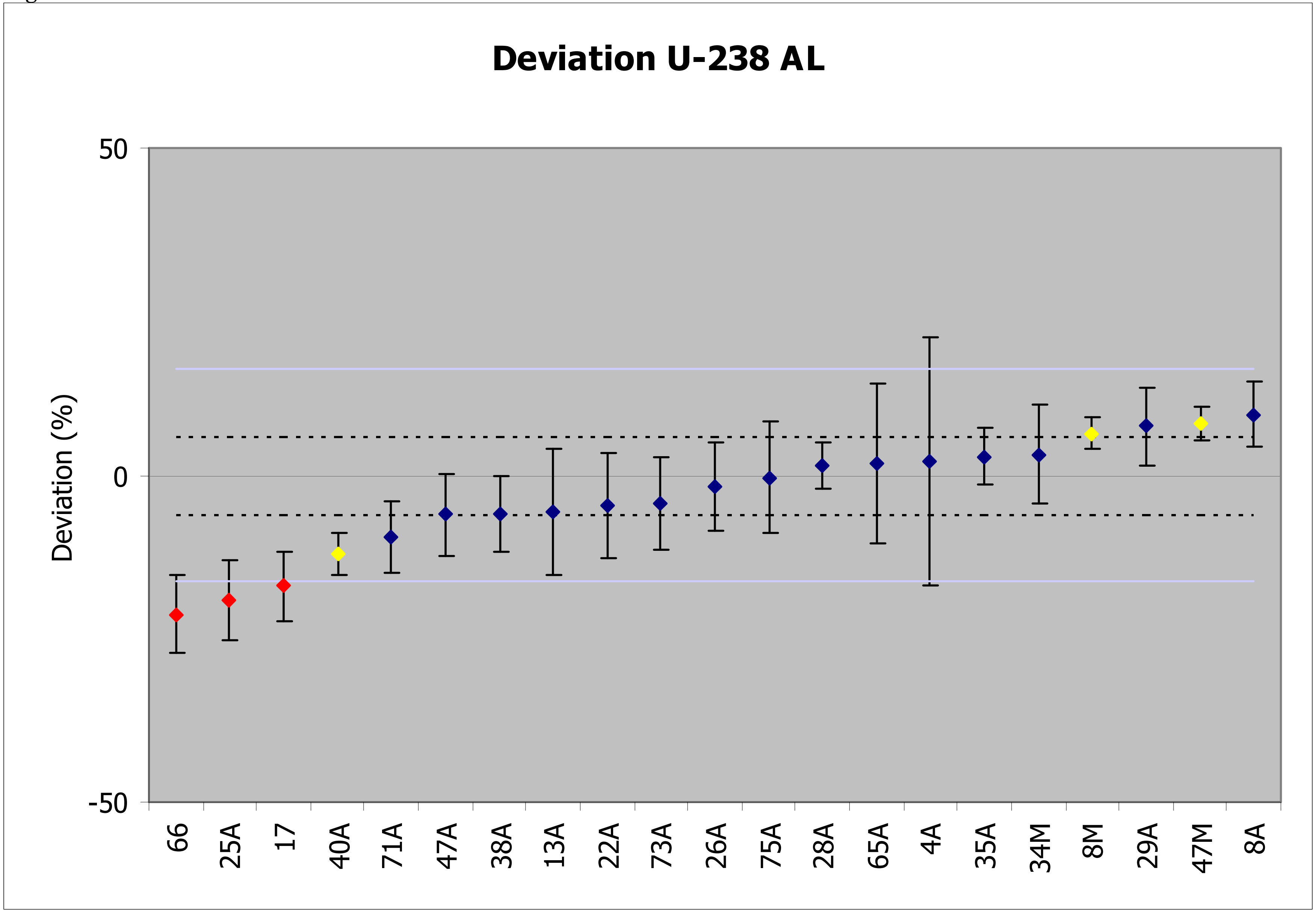


Figure 3B – Zeta score U-238 AL

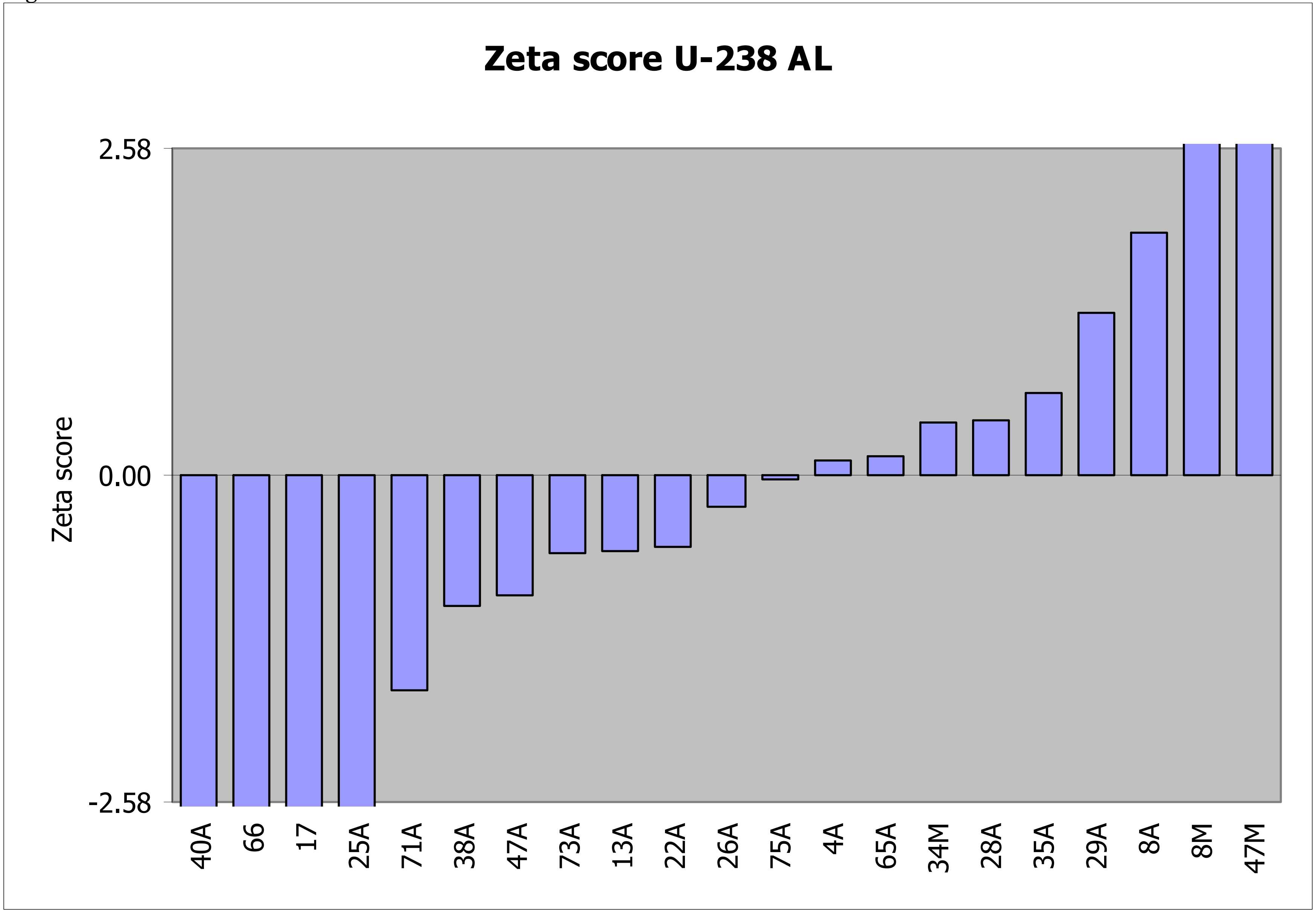


Figure 3C – Relative uncertainty U-238 AL

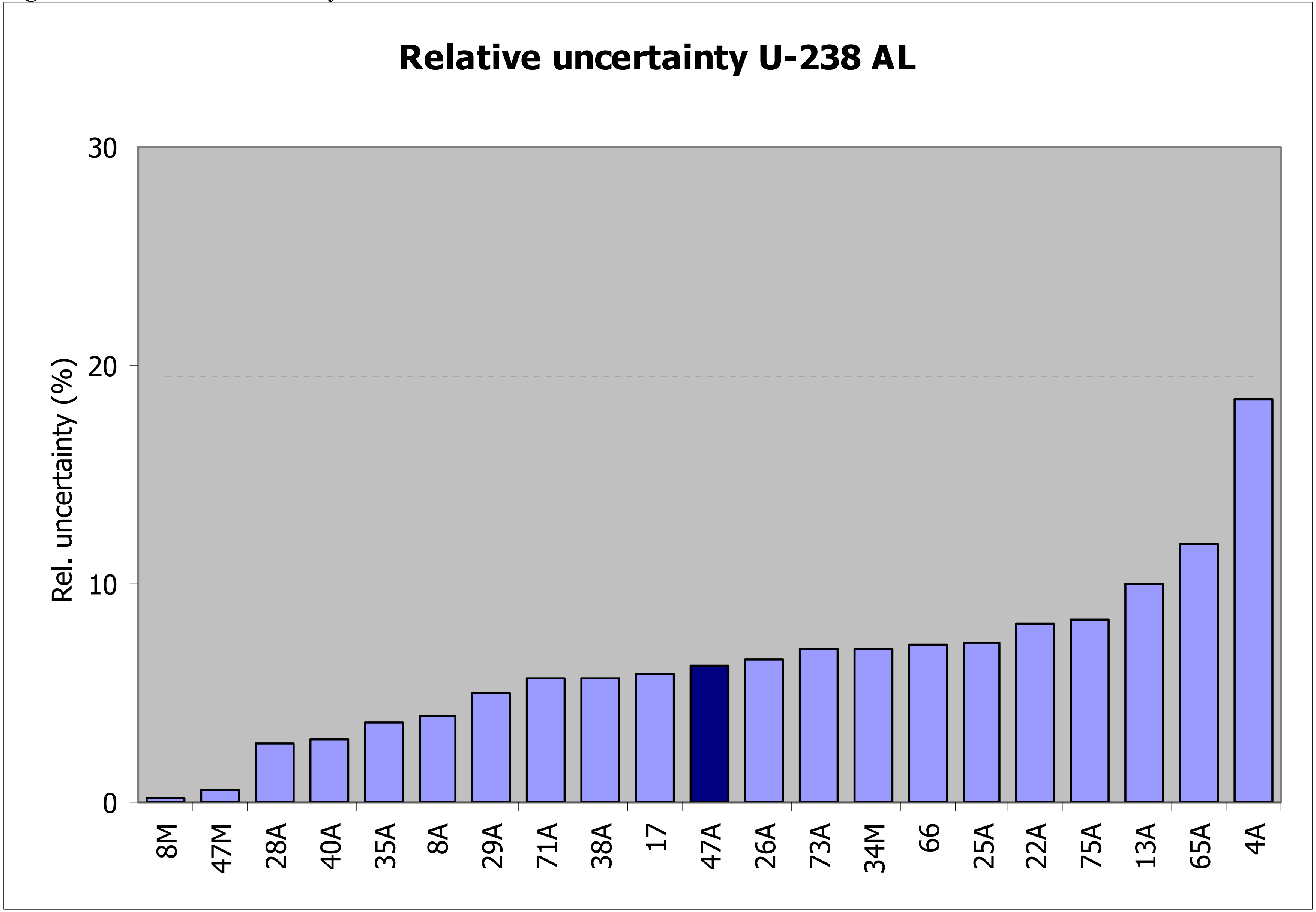


Figure 3D – Kiri plot U-238 AL

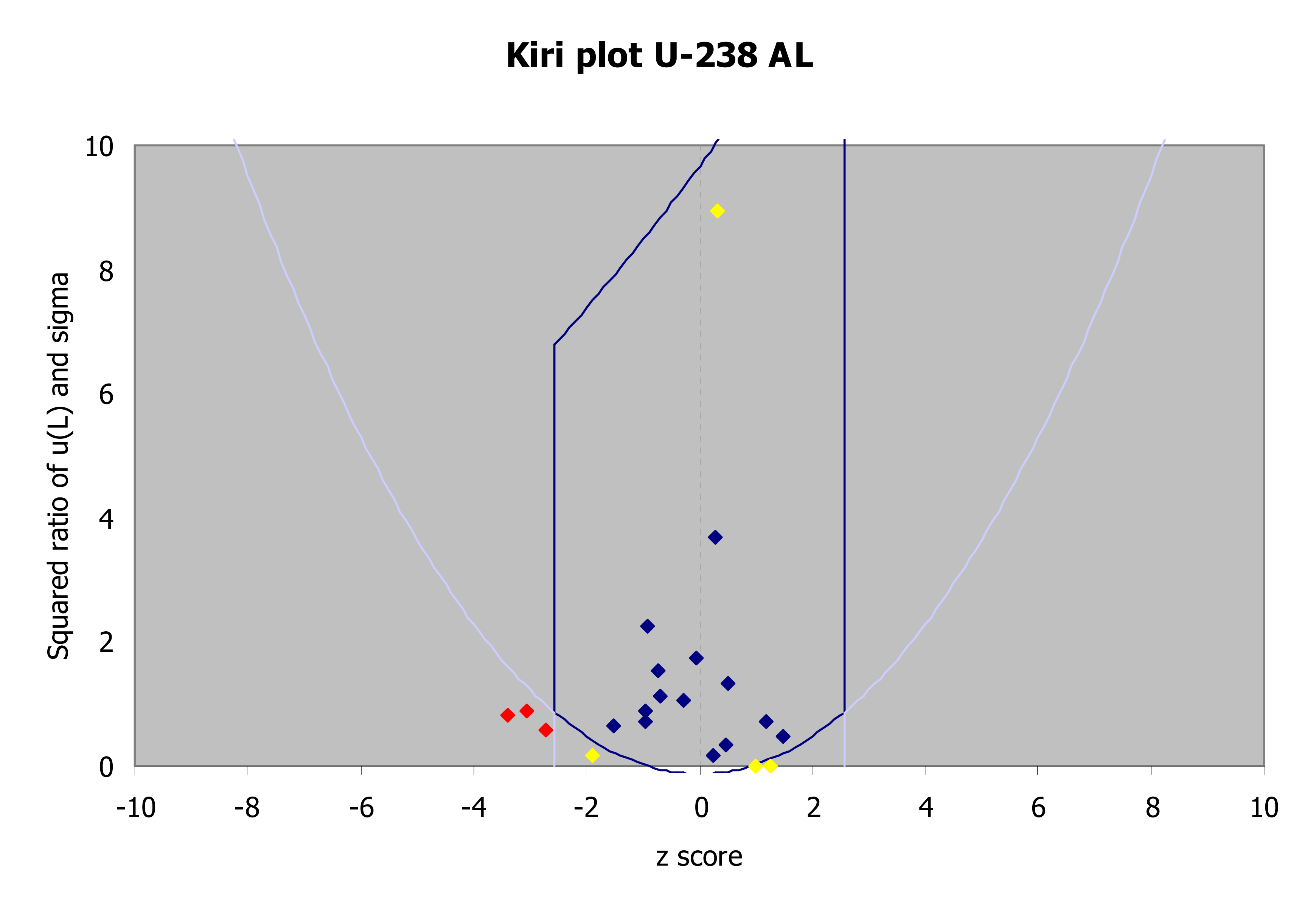


Figure 4A – Deviation Pu-238 AL

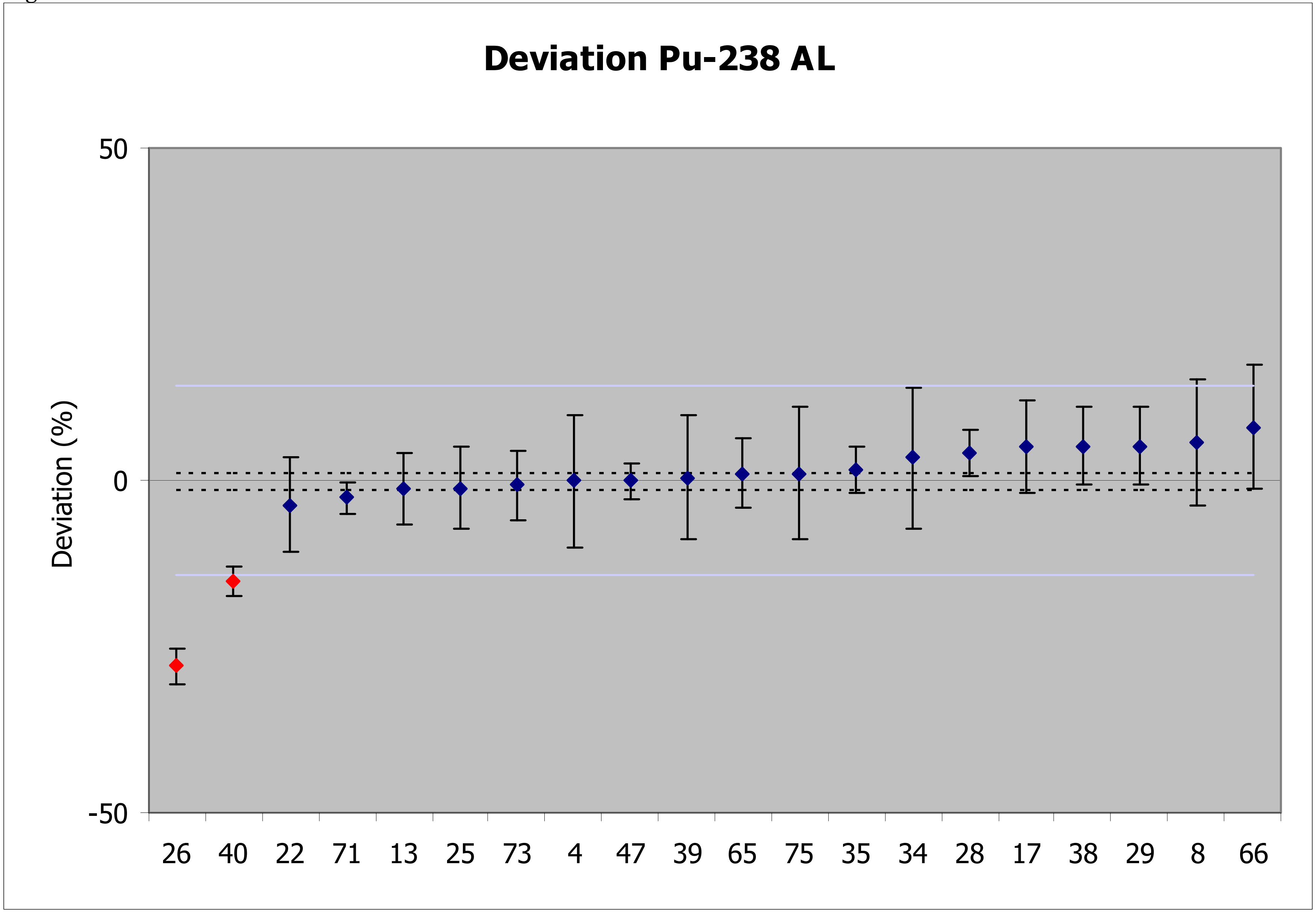


Figure 4B – Zeta score Pu-238 AL

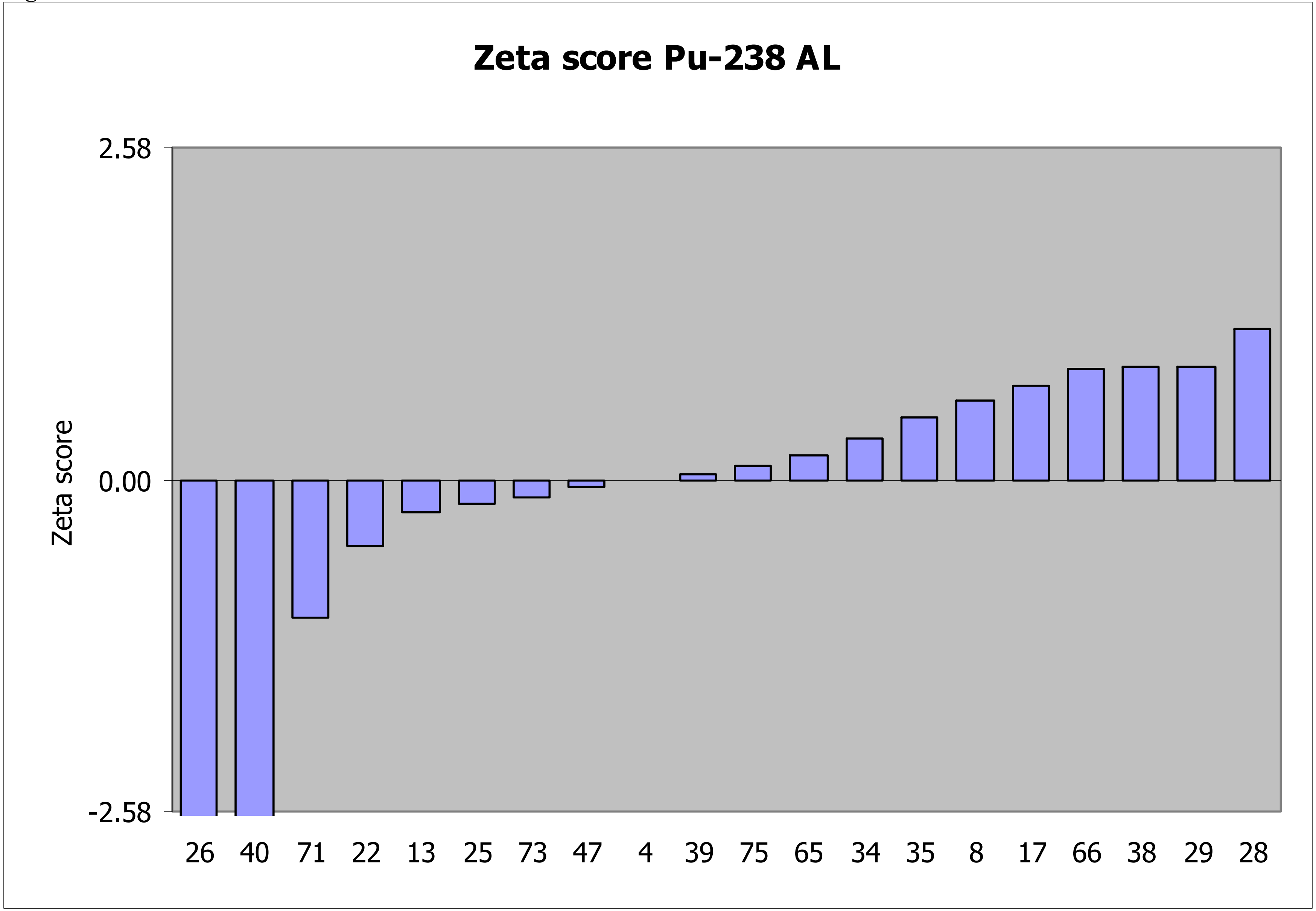


Figure 4C – Relative uncertainty Pu-238 AL

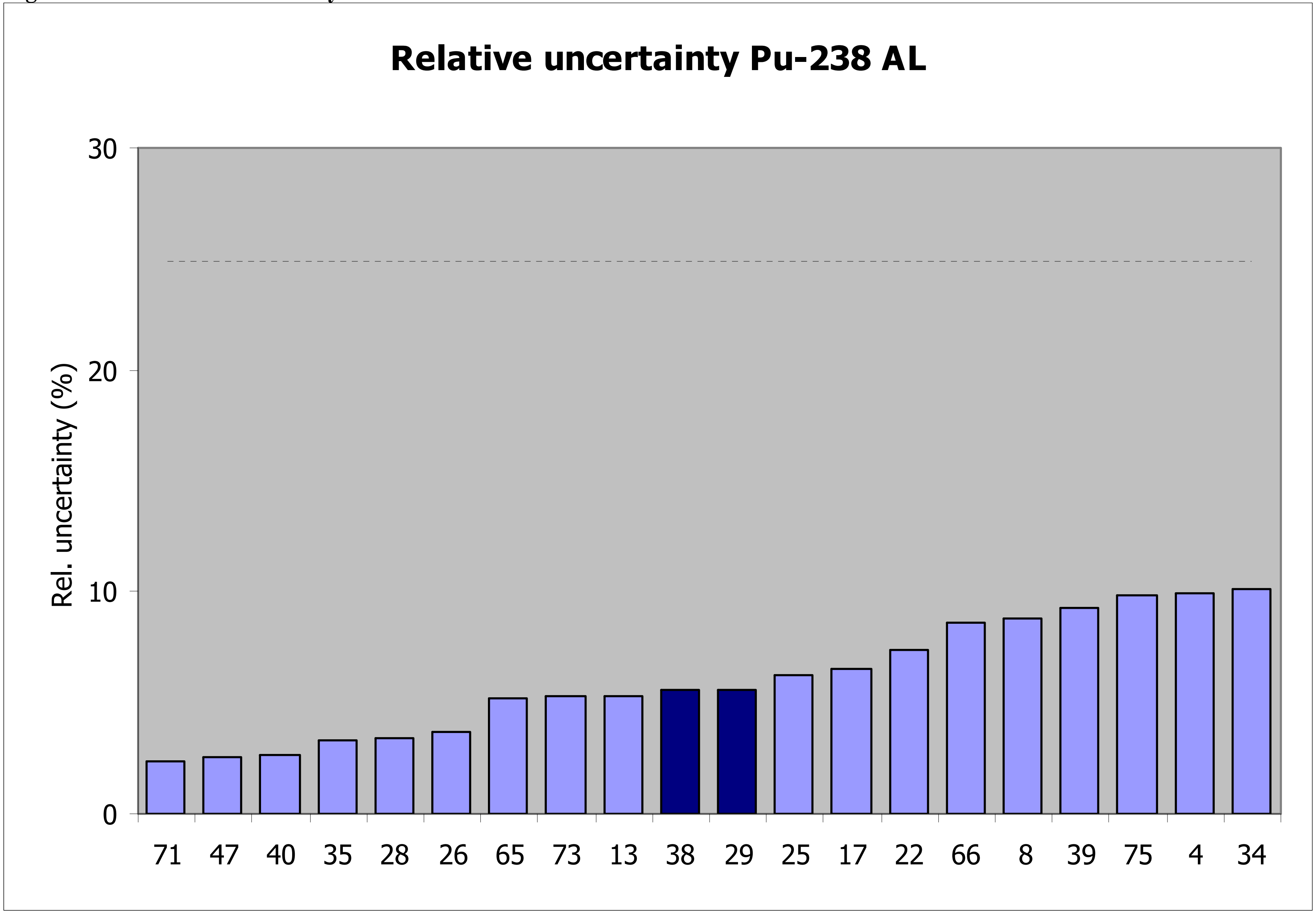


Figure 4D – Kiri plot Pu-238 AL

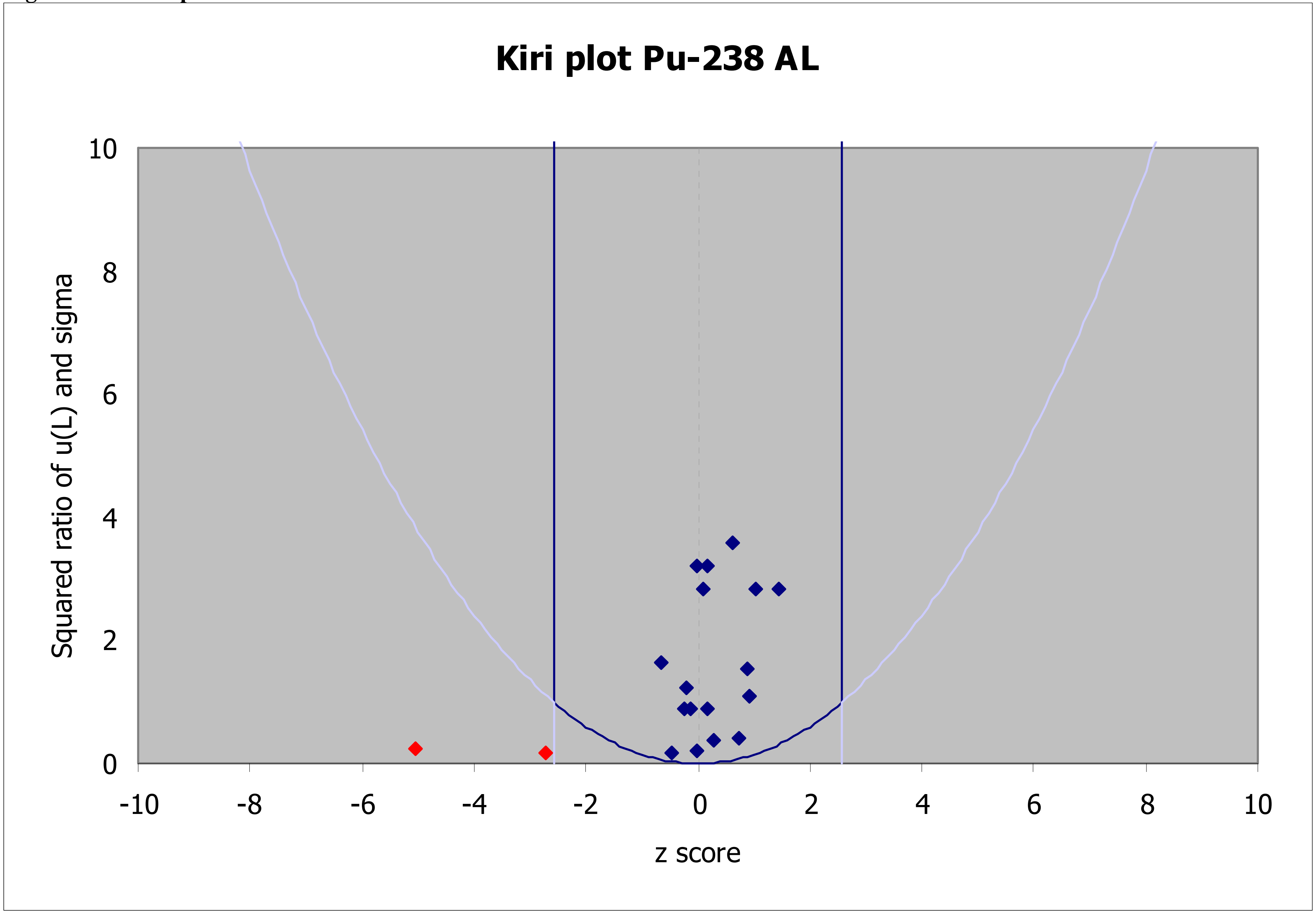


Figure 5A – Deviation Pu-239 AL

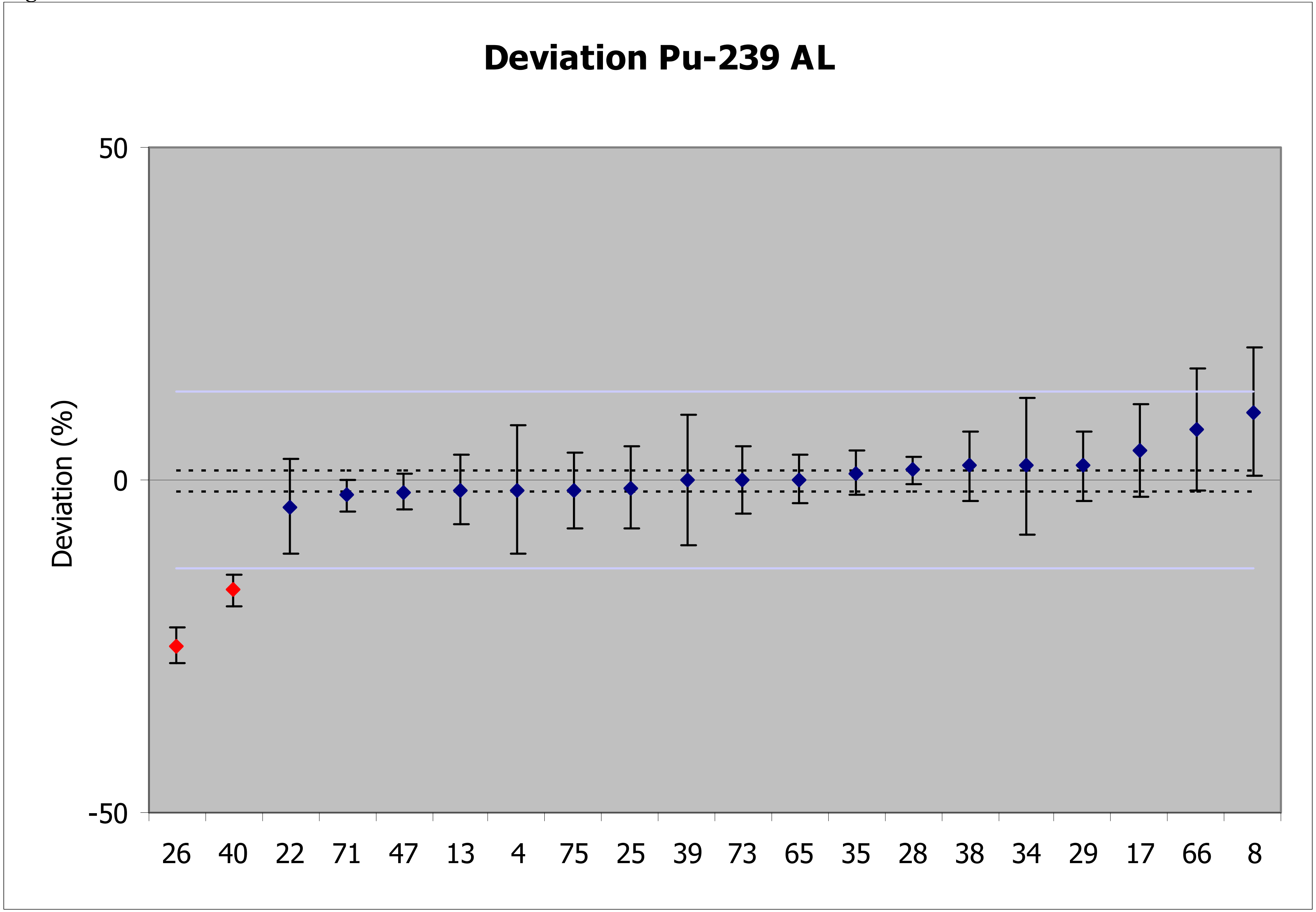


Figure 5B – Zeta score Pu-239 AL

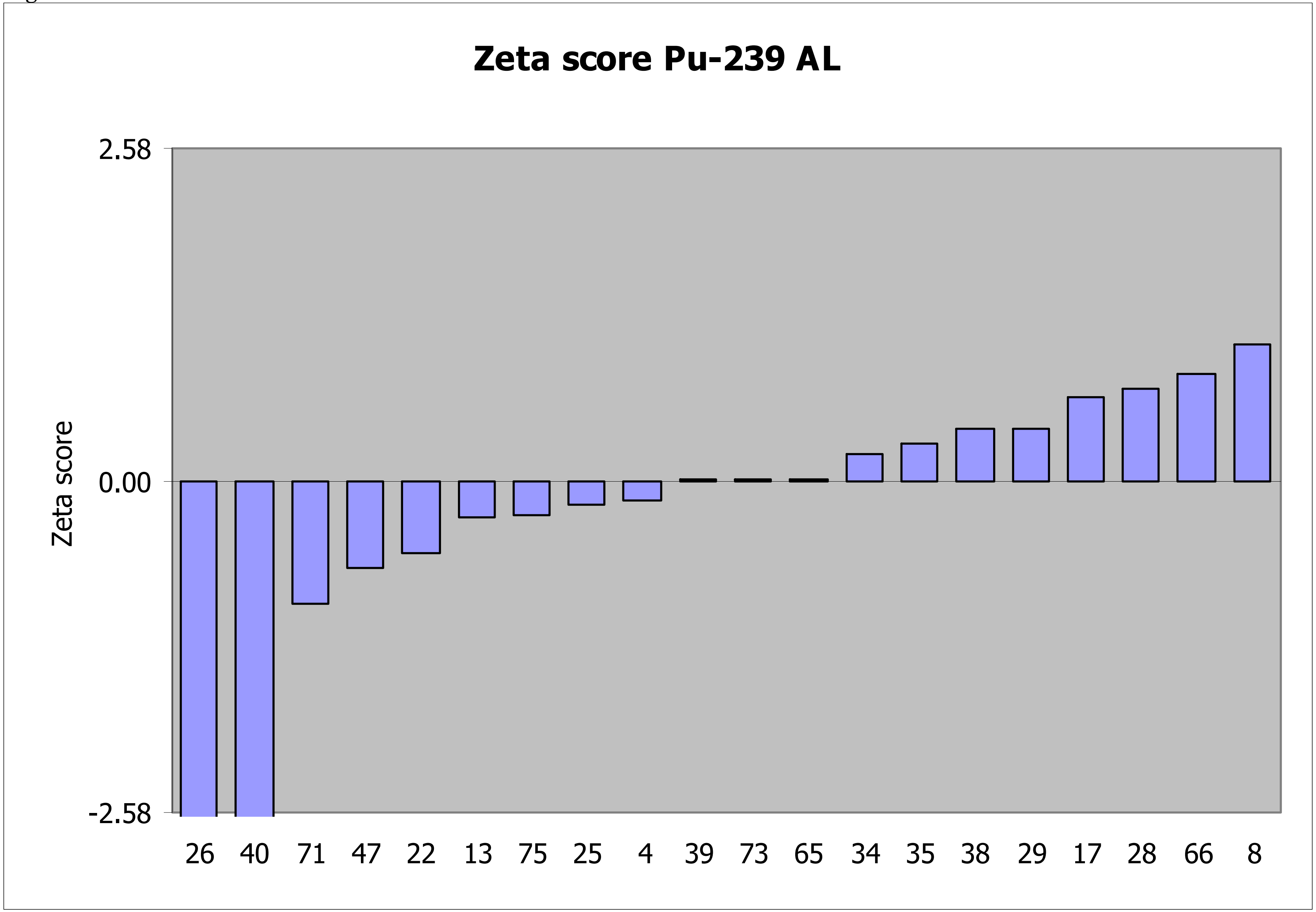


Figure 5C – Relative uncertainty Pu-239 AL

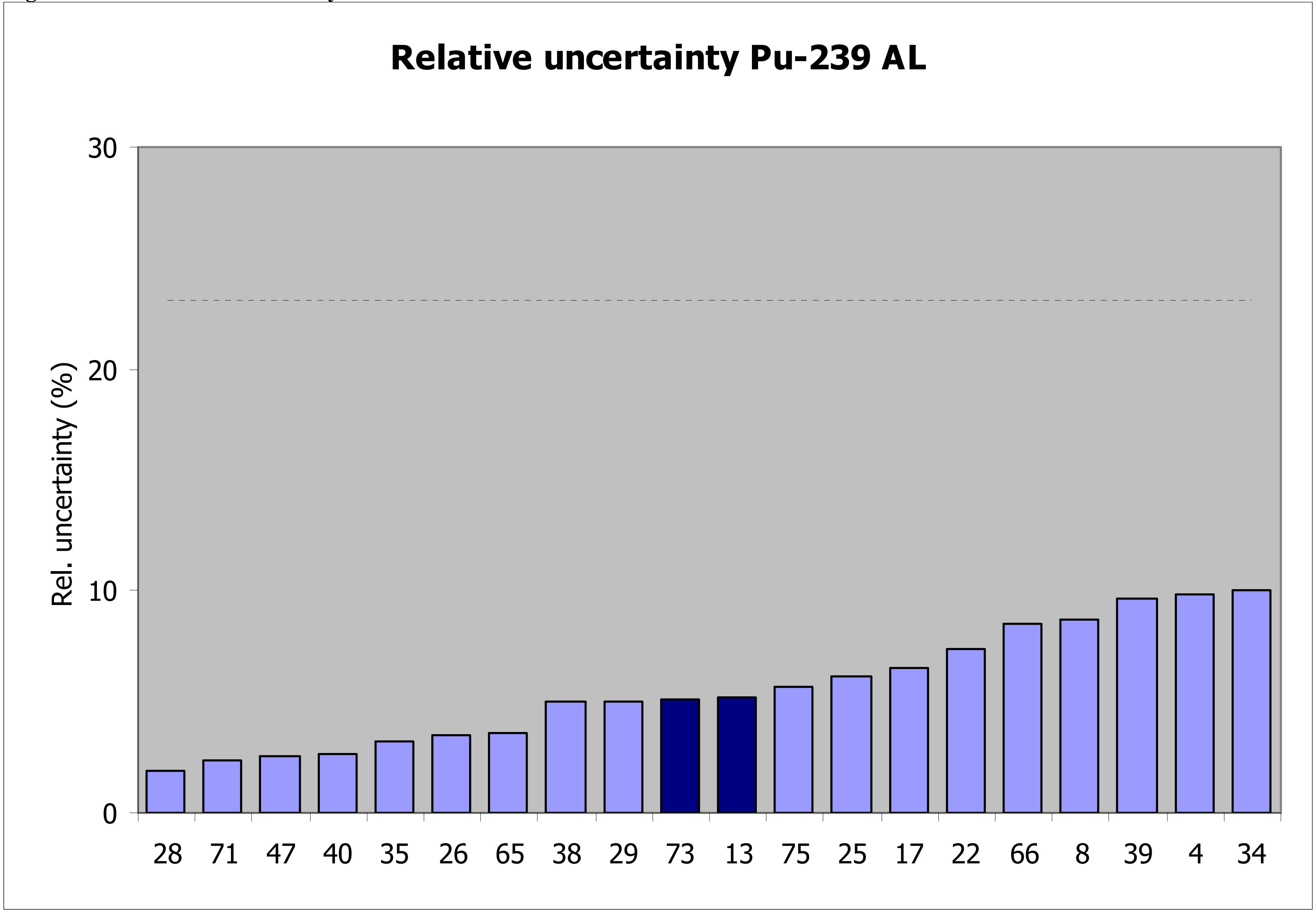


Figure 5D – Kiri plot Pu-239 AL

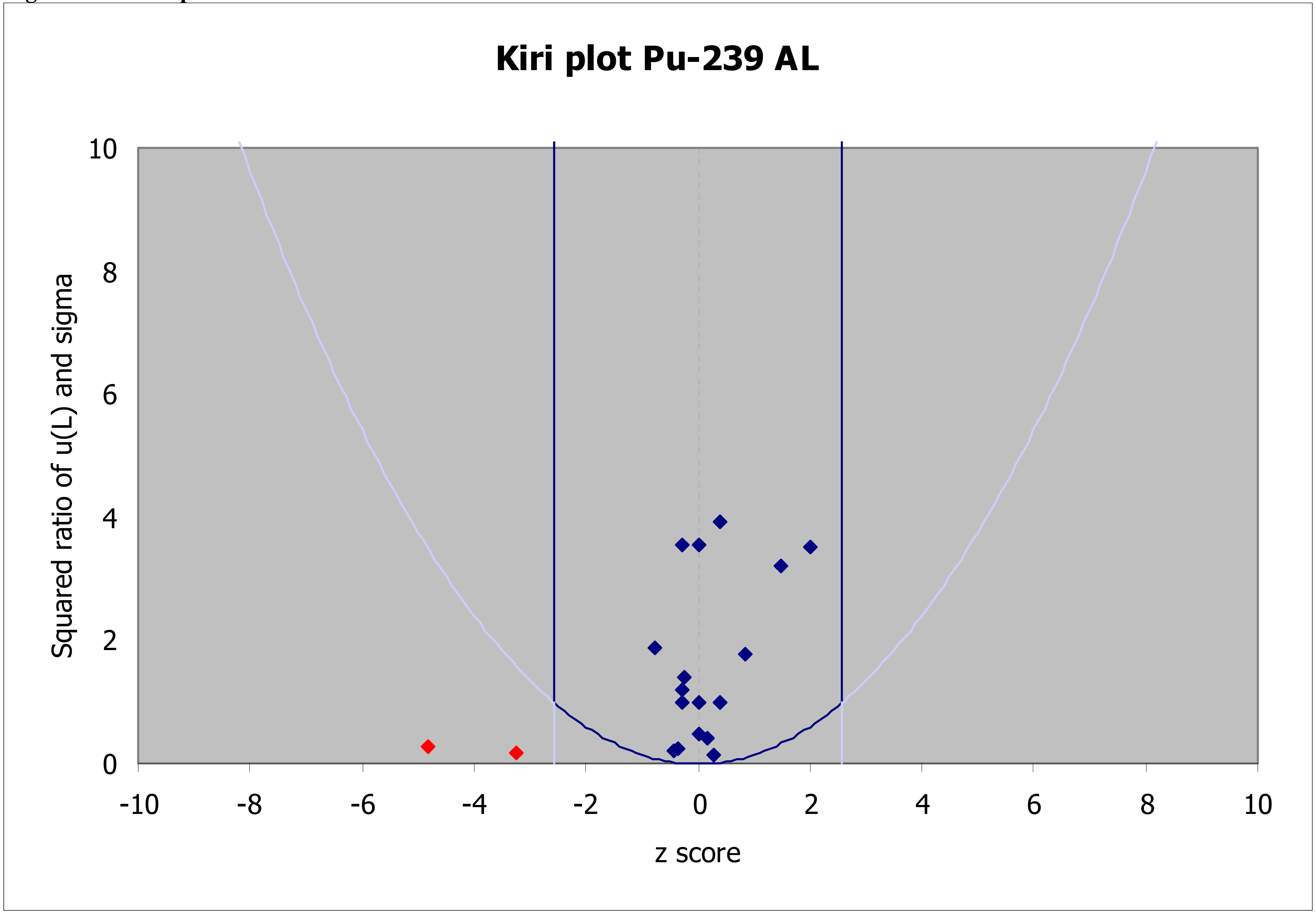


Figure 6A – Deviation Am-241 AL

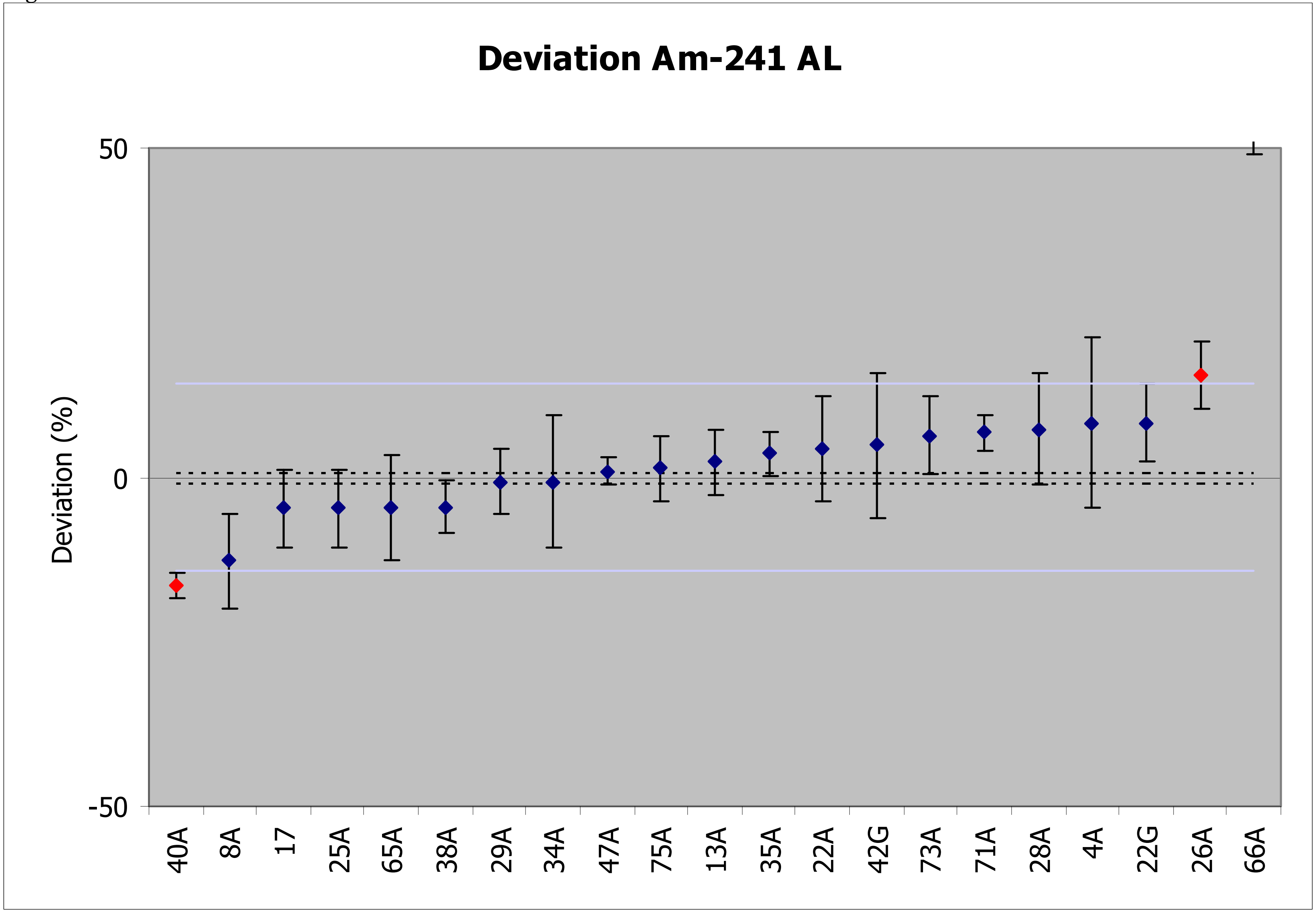


Figure 6B – Zeta score Am-241 AL

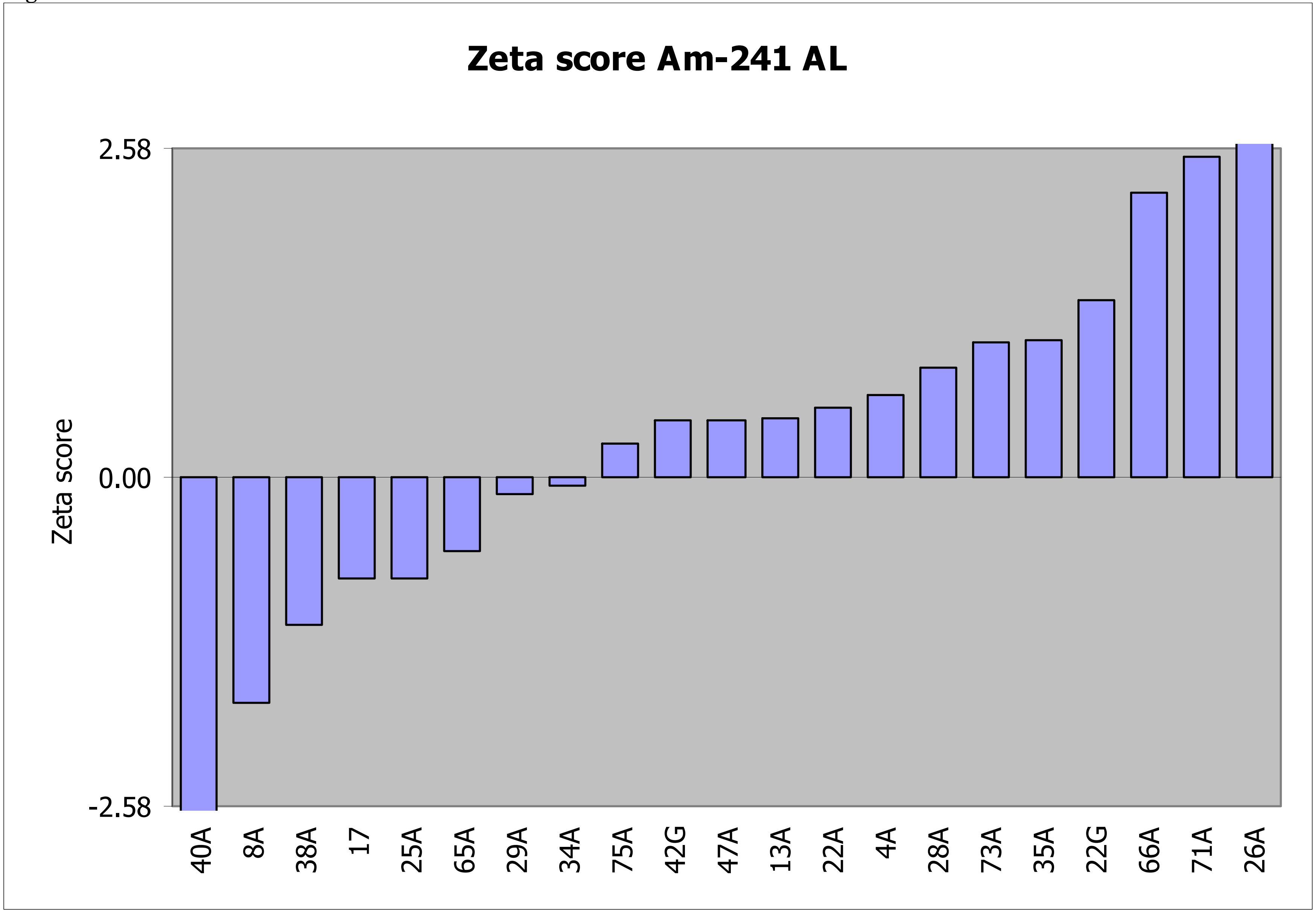


Figure 6C – Relative uncertainty Am-241 AL

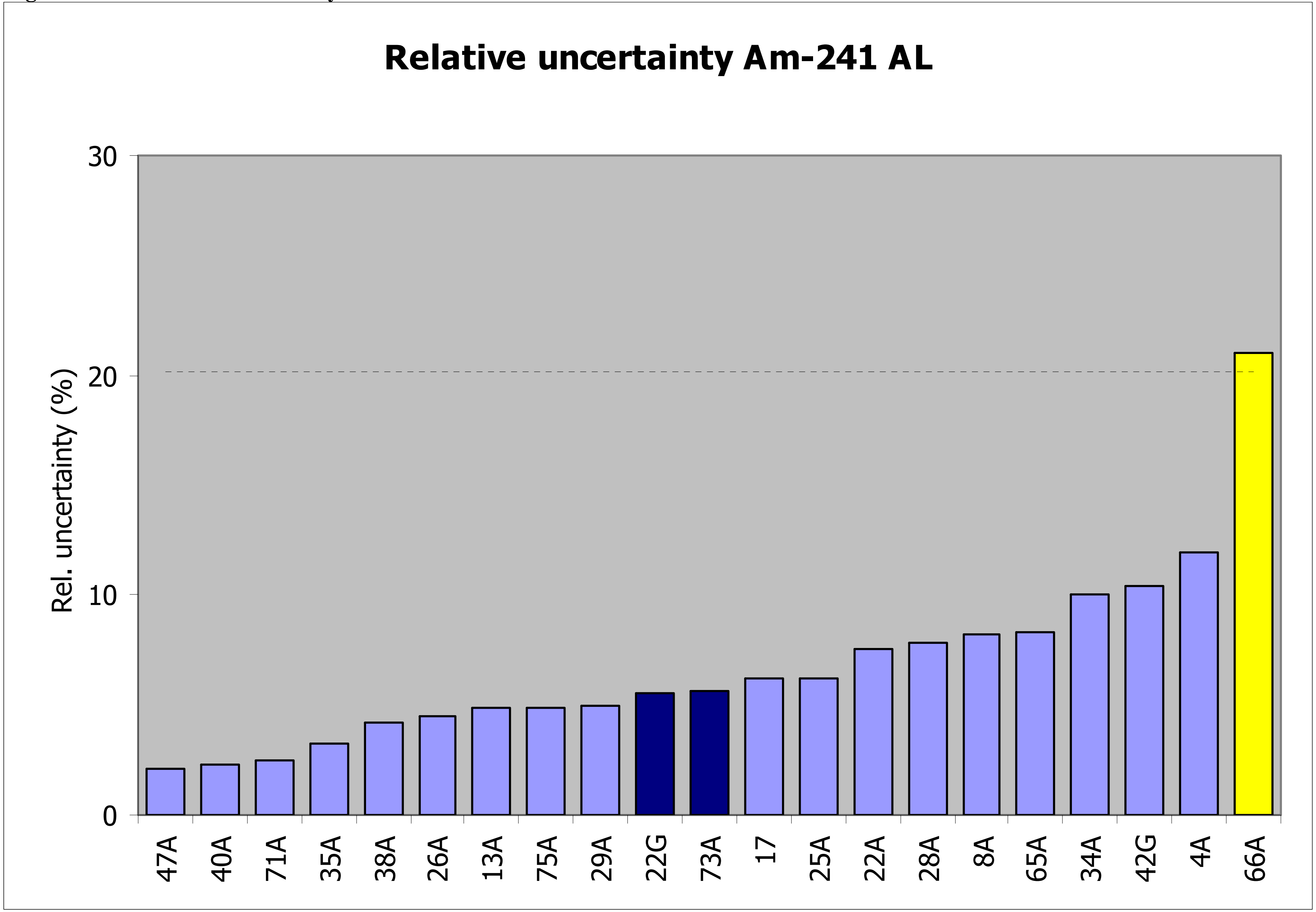


Figure 6D – Kiri plot Am-241 AL

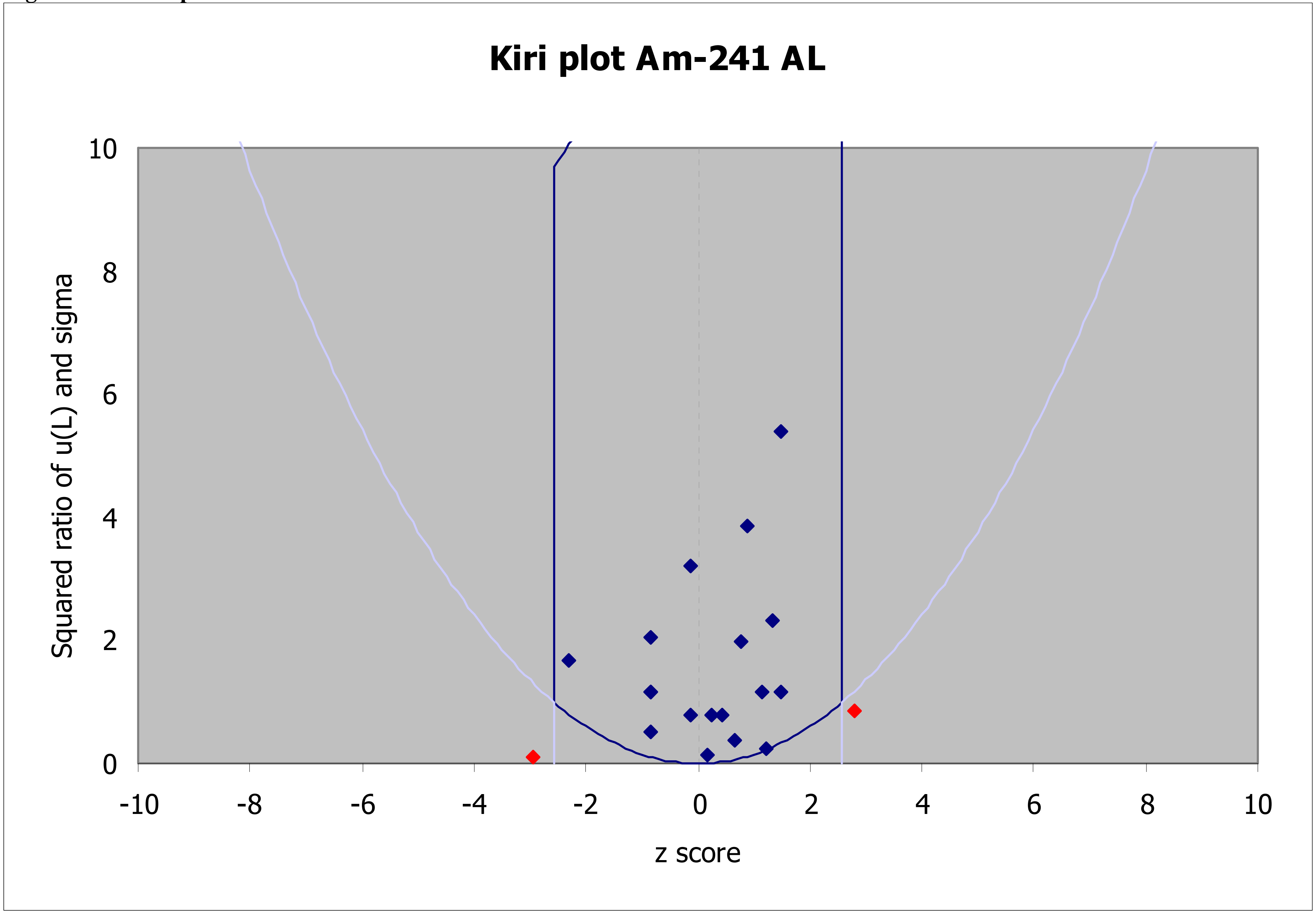


Figure 7A – Deviation Cm-244 AL

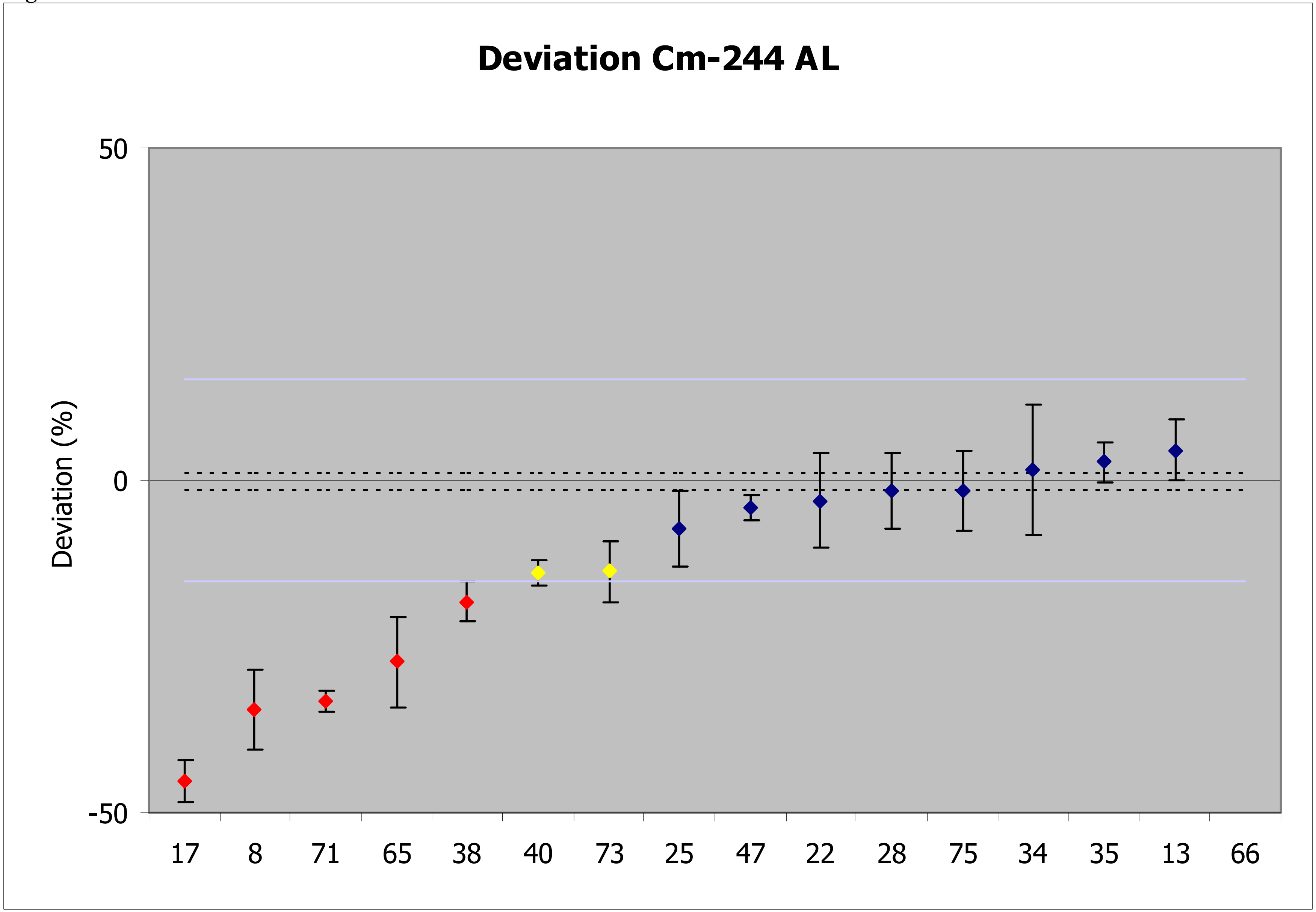


Figure 7B – Zeta score Cm-244 AL

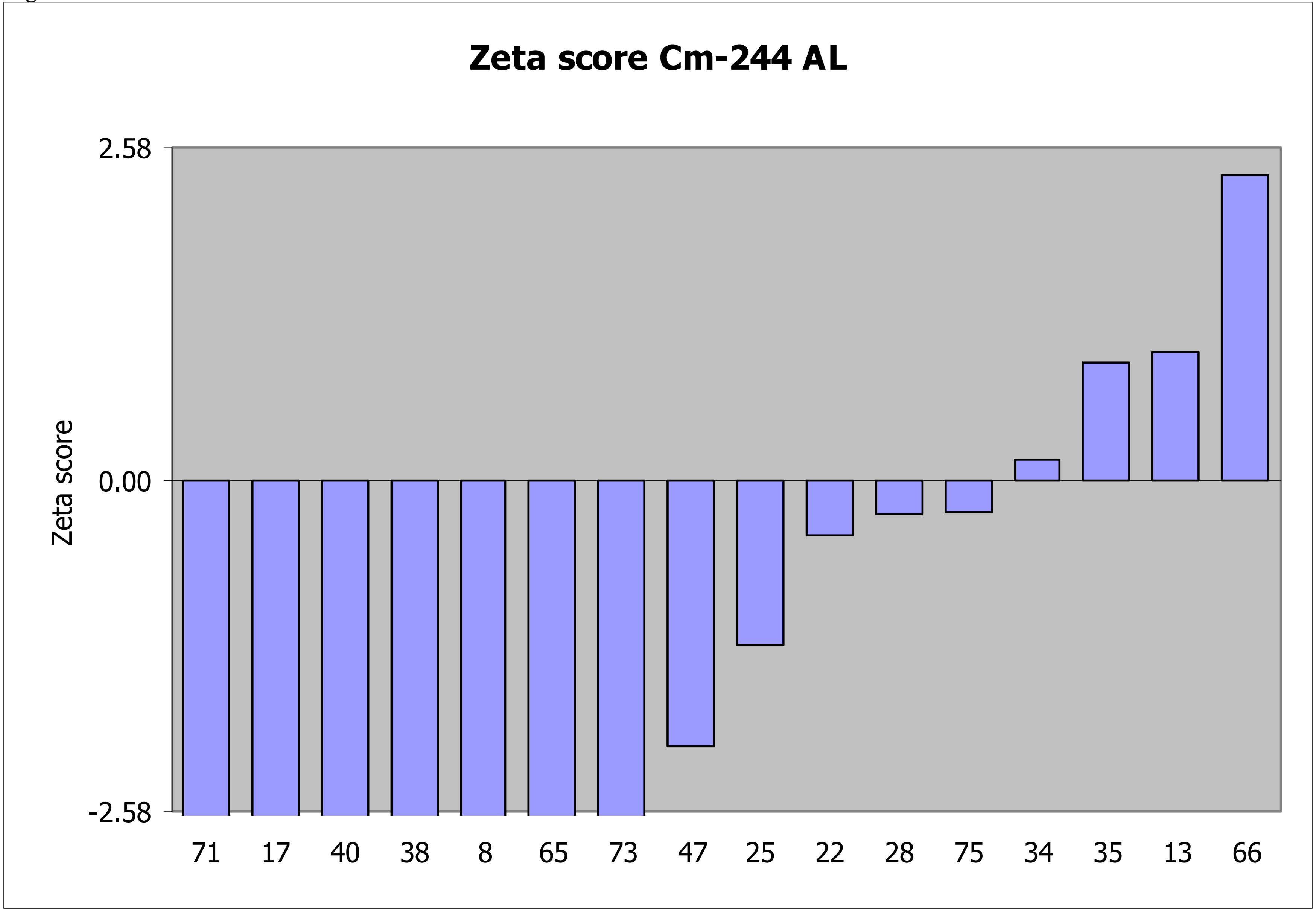


Figure 7C – Relative uncertainty Cm-244 AL

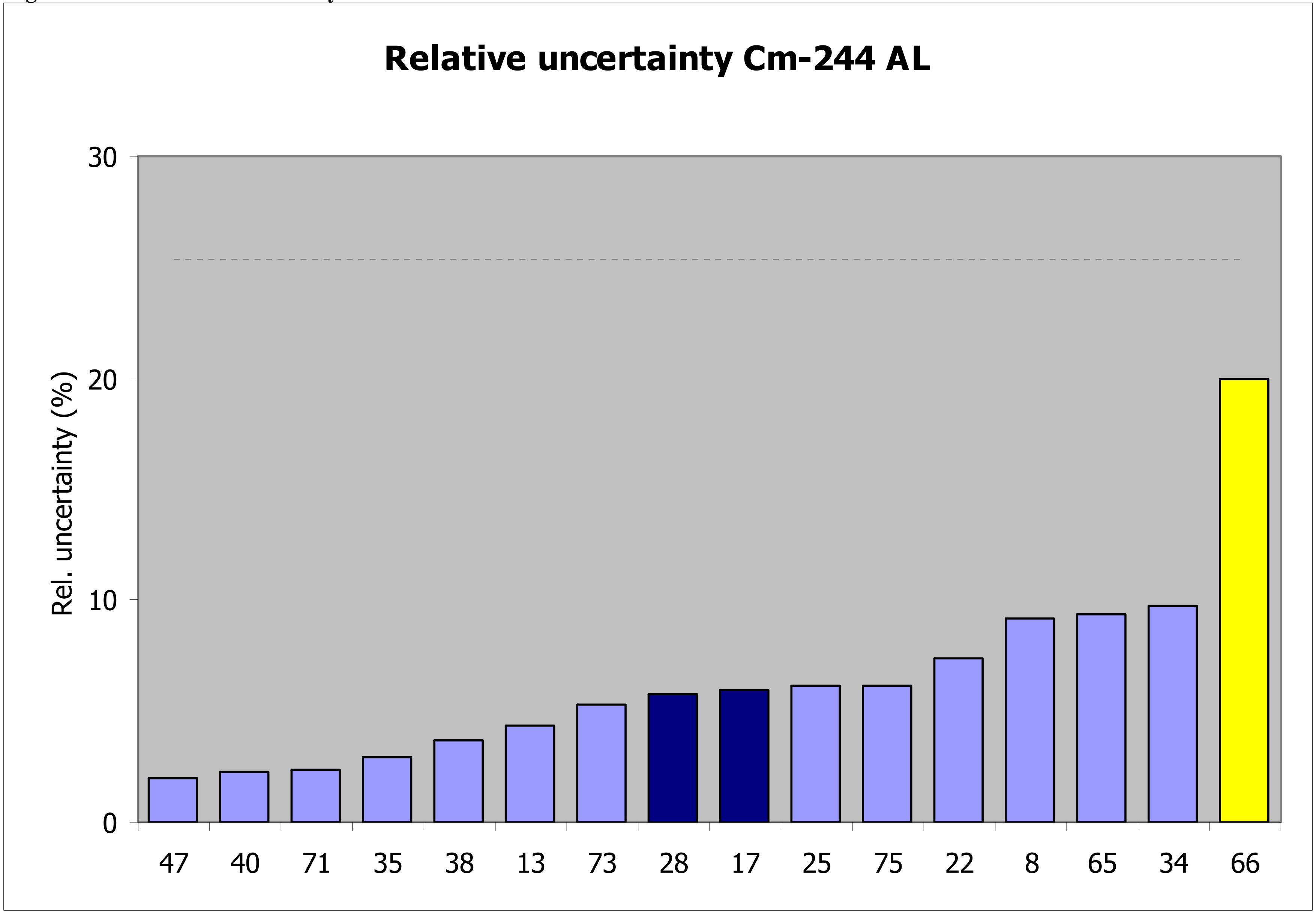


Figure 7D – Kiri plot Cm-244 AL

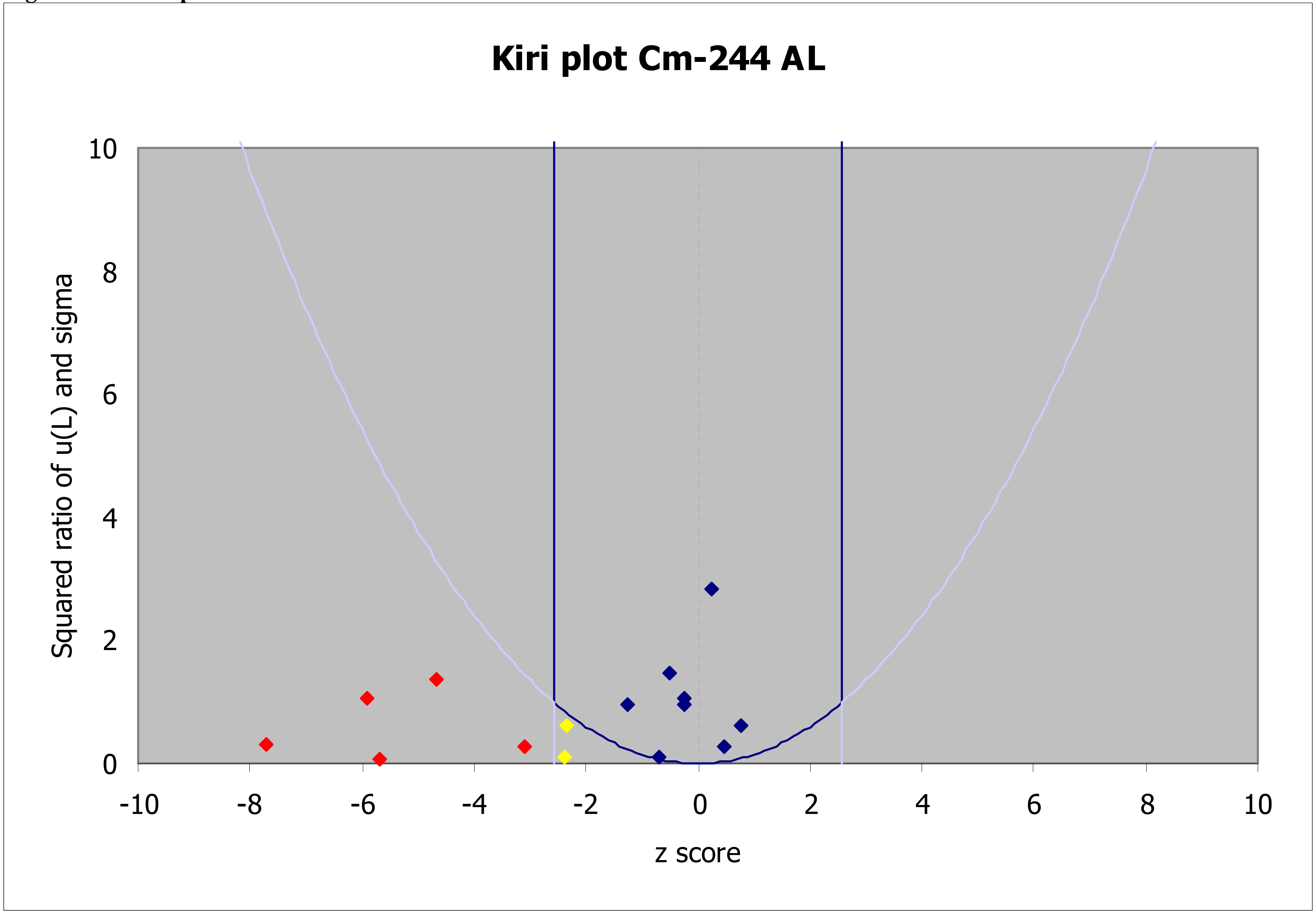


Figure 8A – Deviation gross alpha AL

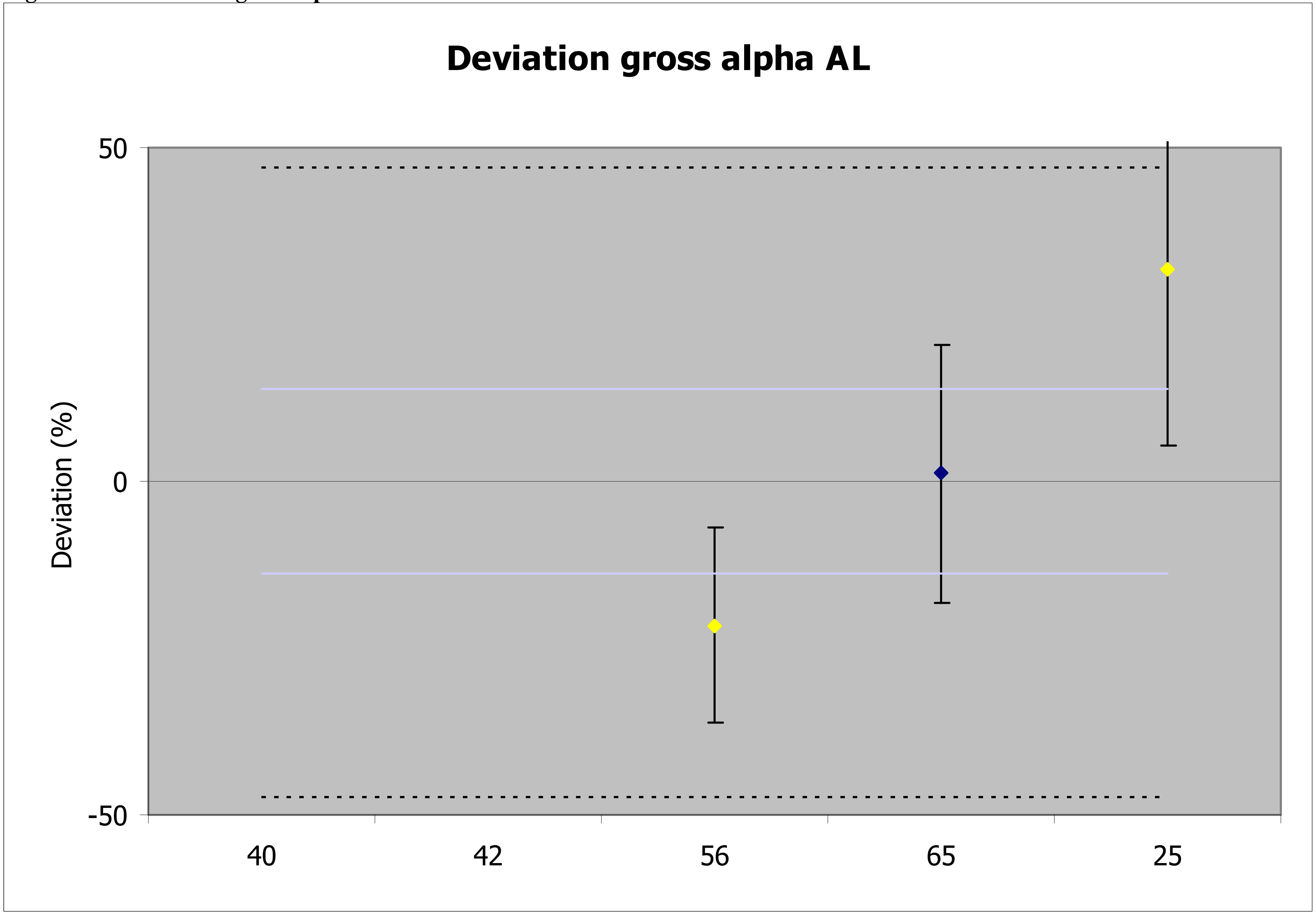


Figure 8B – Zeta score gross alpha AL

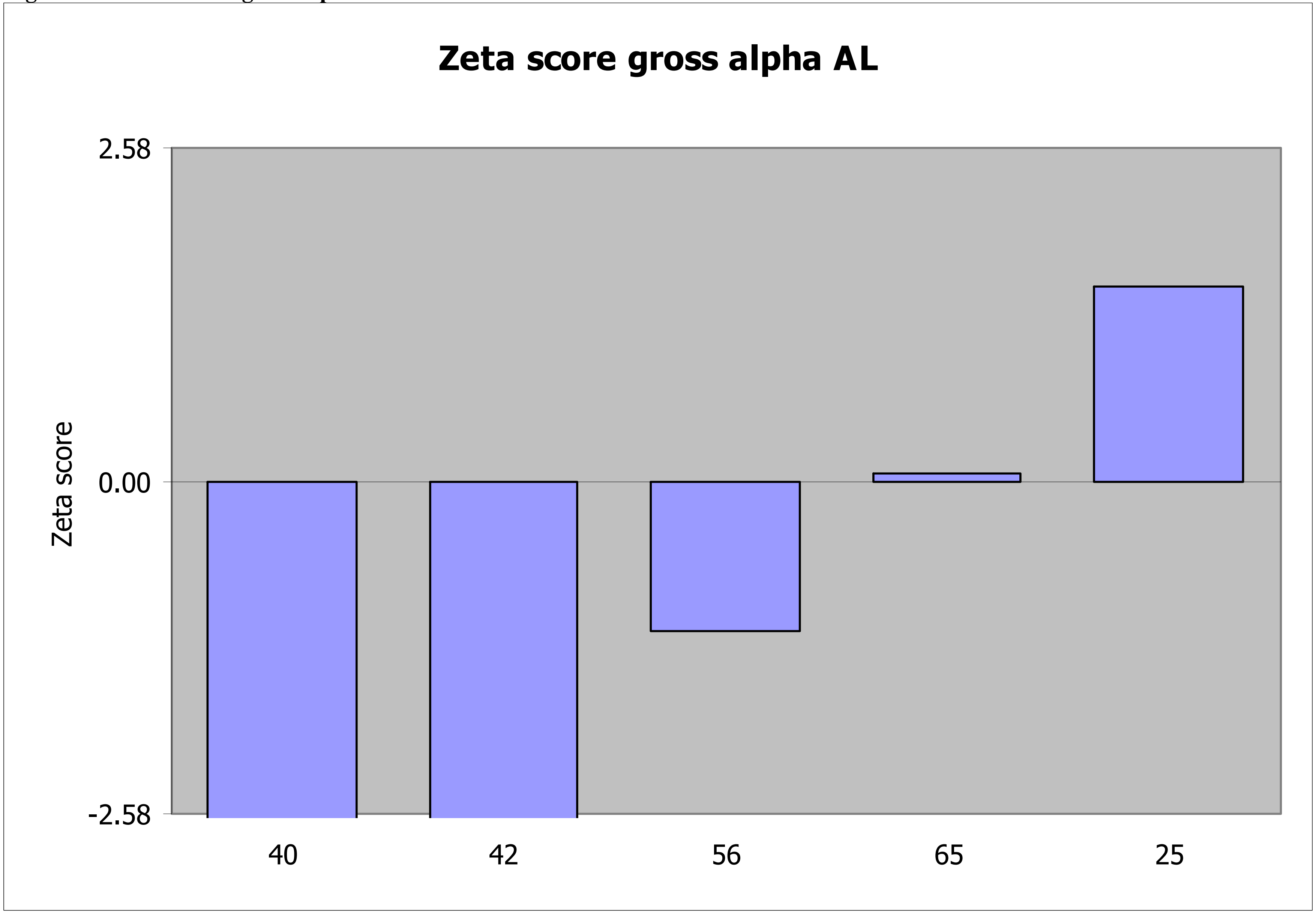


Figure 8C – Relative uncertainty gross alpha AL

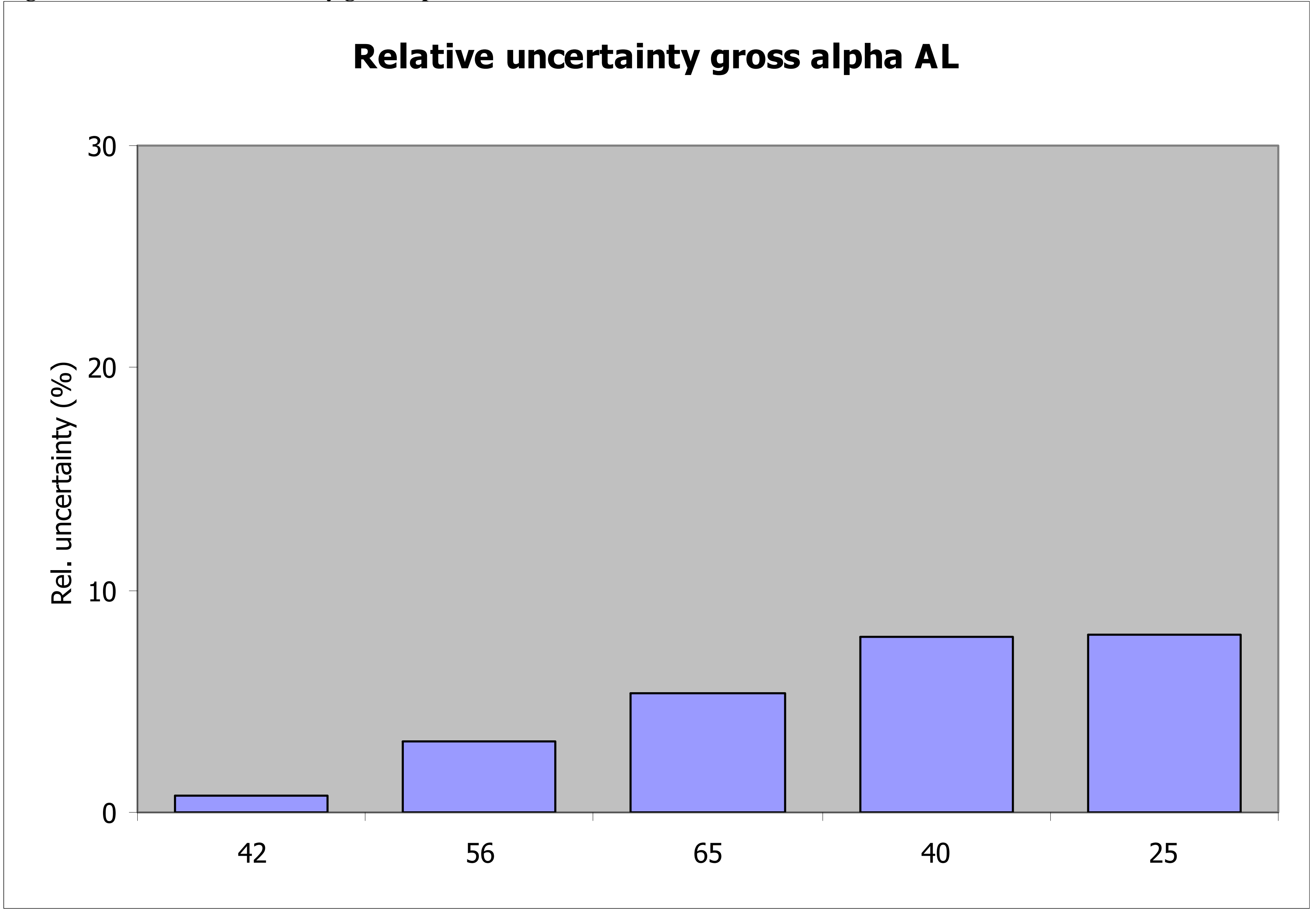


Figure 8D – Kiri plot gross alpha AL

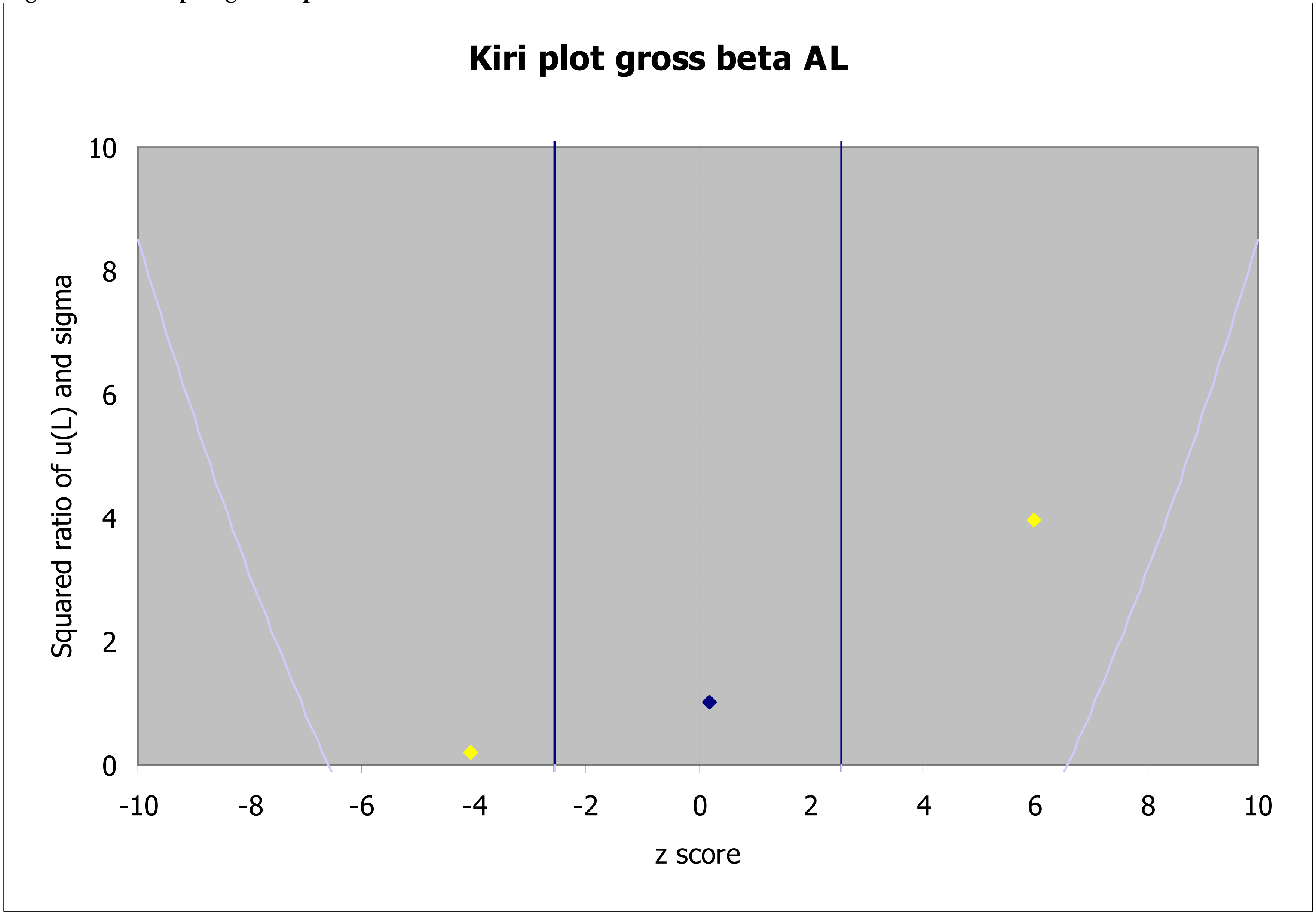


Figure 9A – Deviation Ra-226 AH

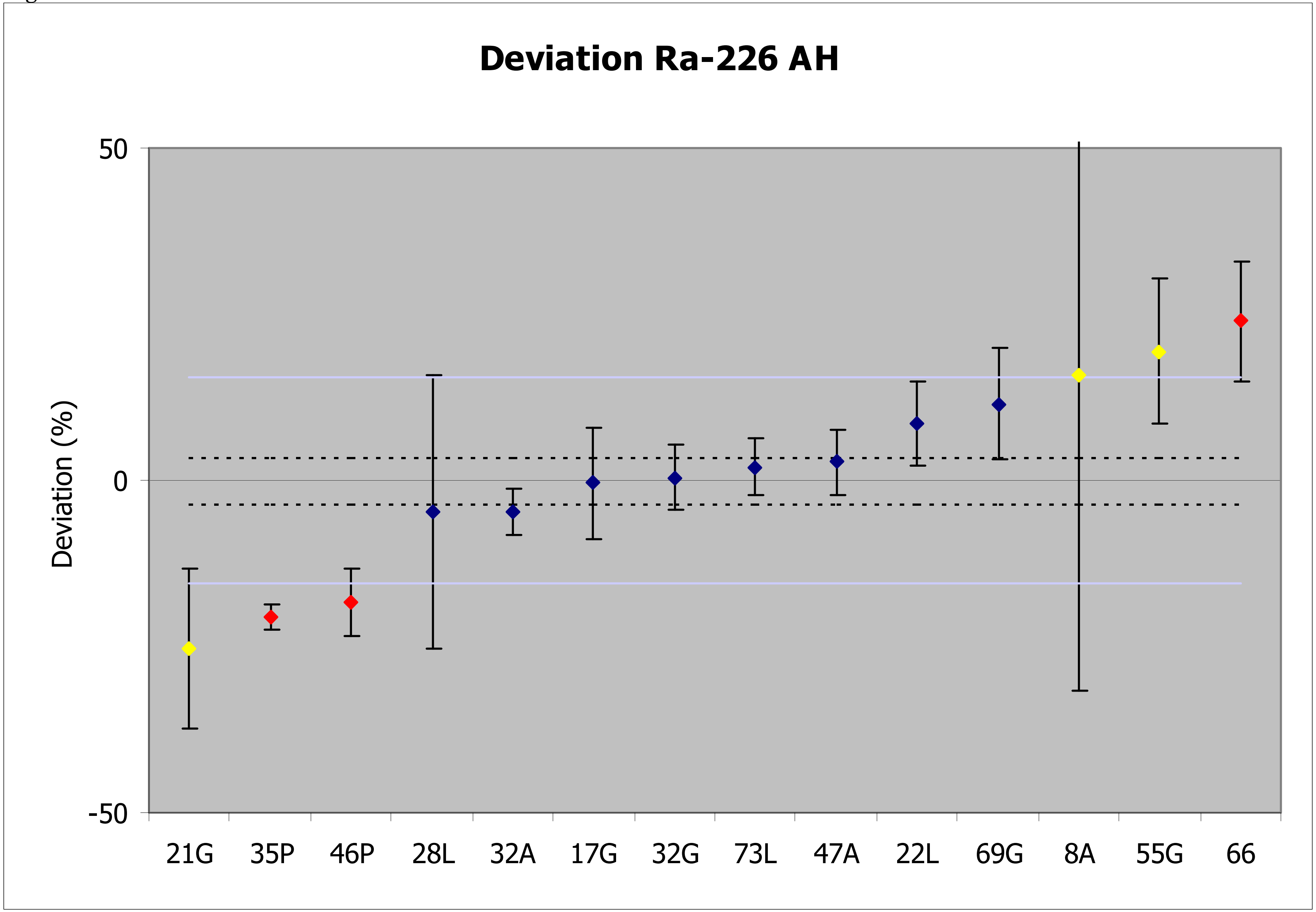


Figure 9B – Zeta score Ra-226 AH

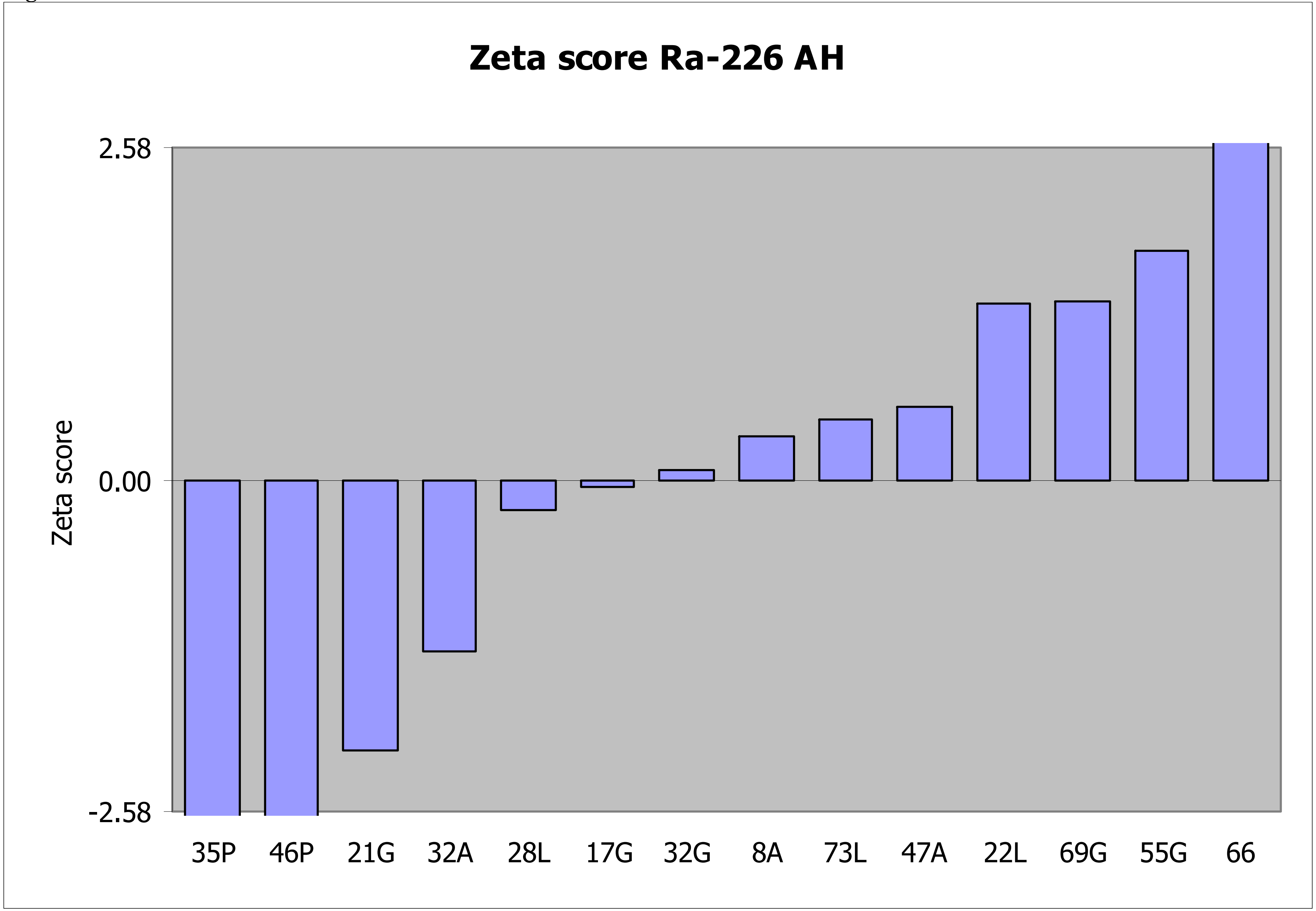


Figure 9C – Relative uncertainty Ra-226 AH

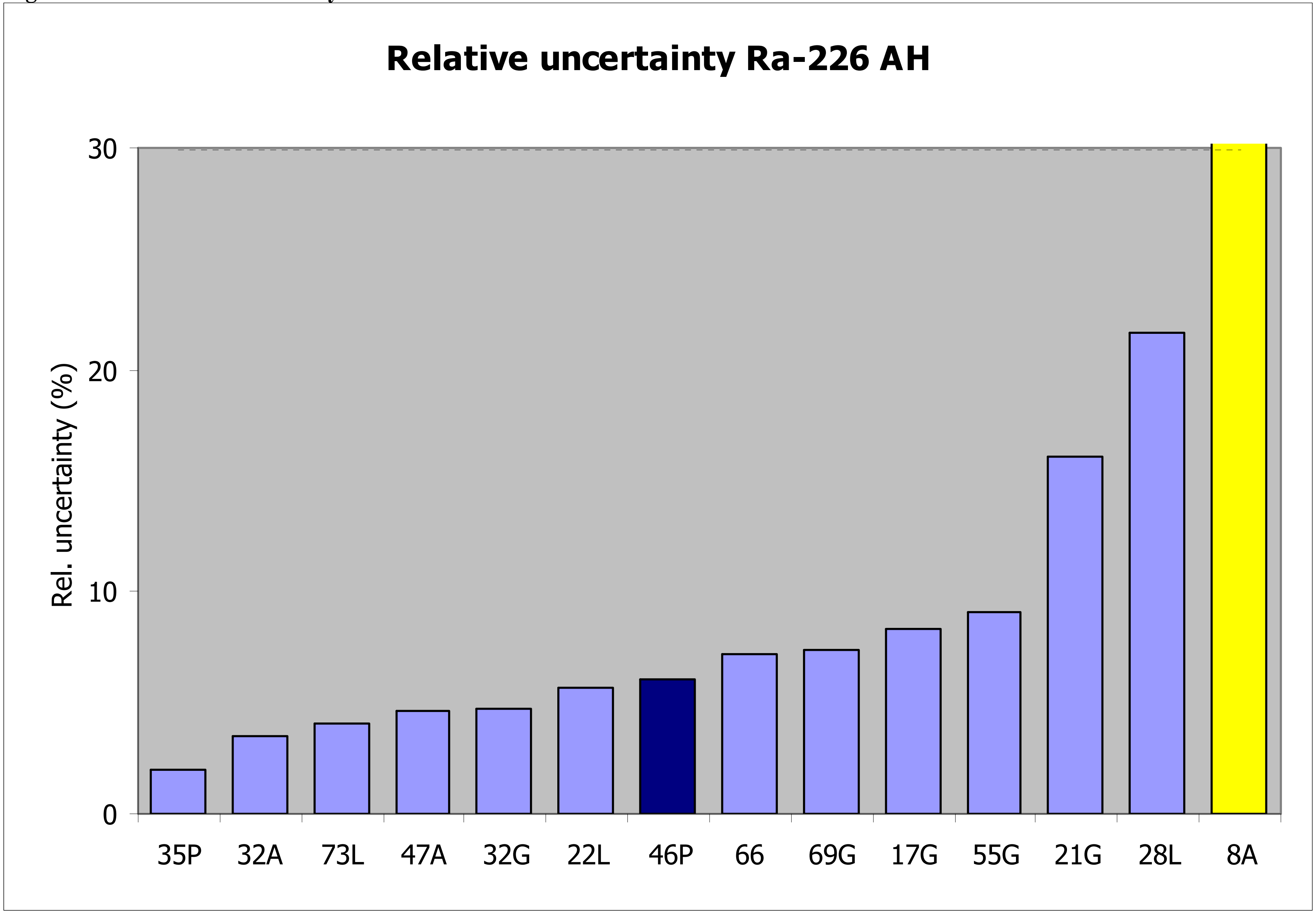


Figure 9D – Kiri plot Ra-226 AH

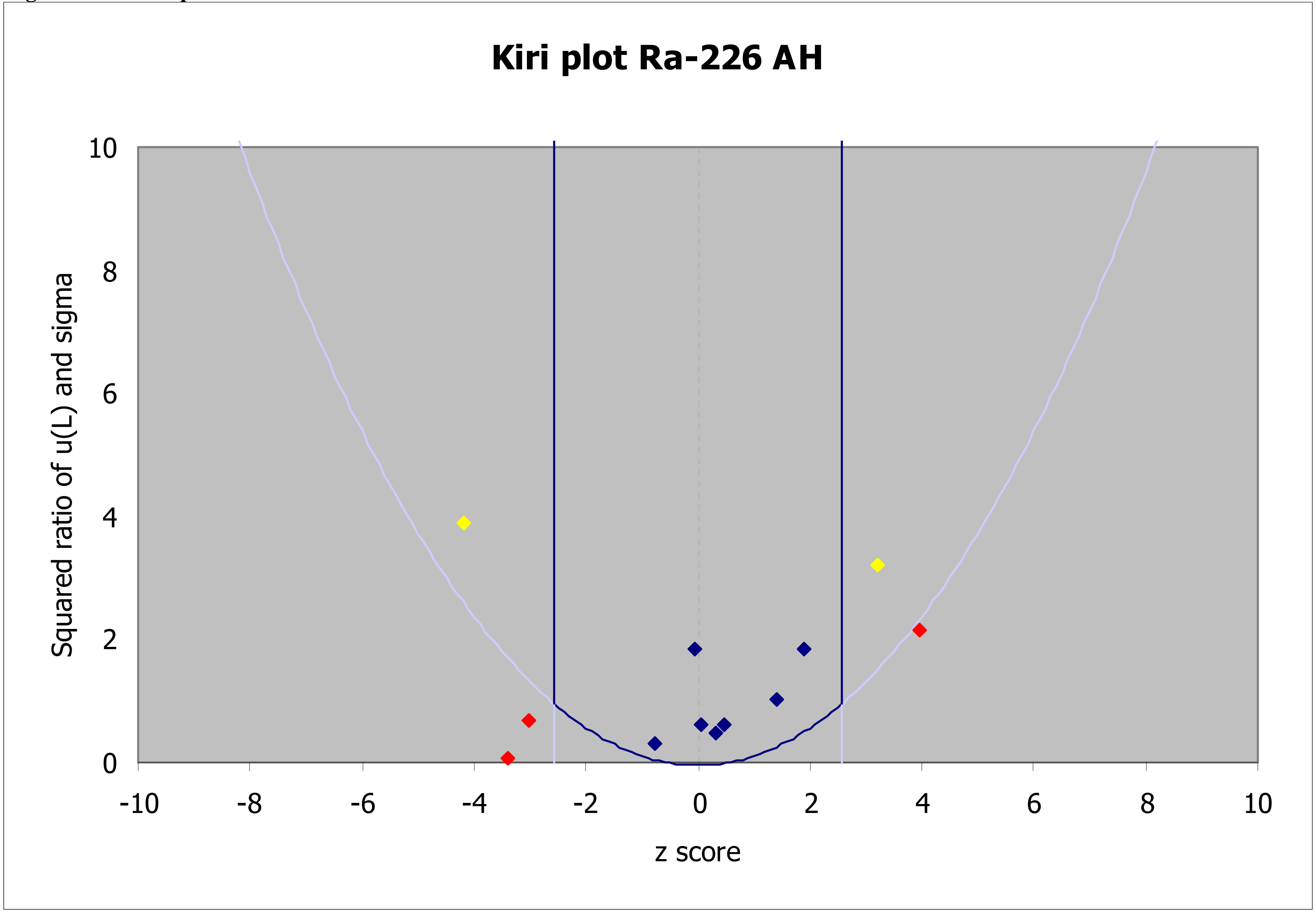


Figure 10A – Deviation Np-237 AH

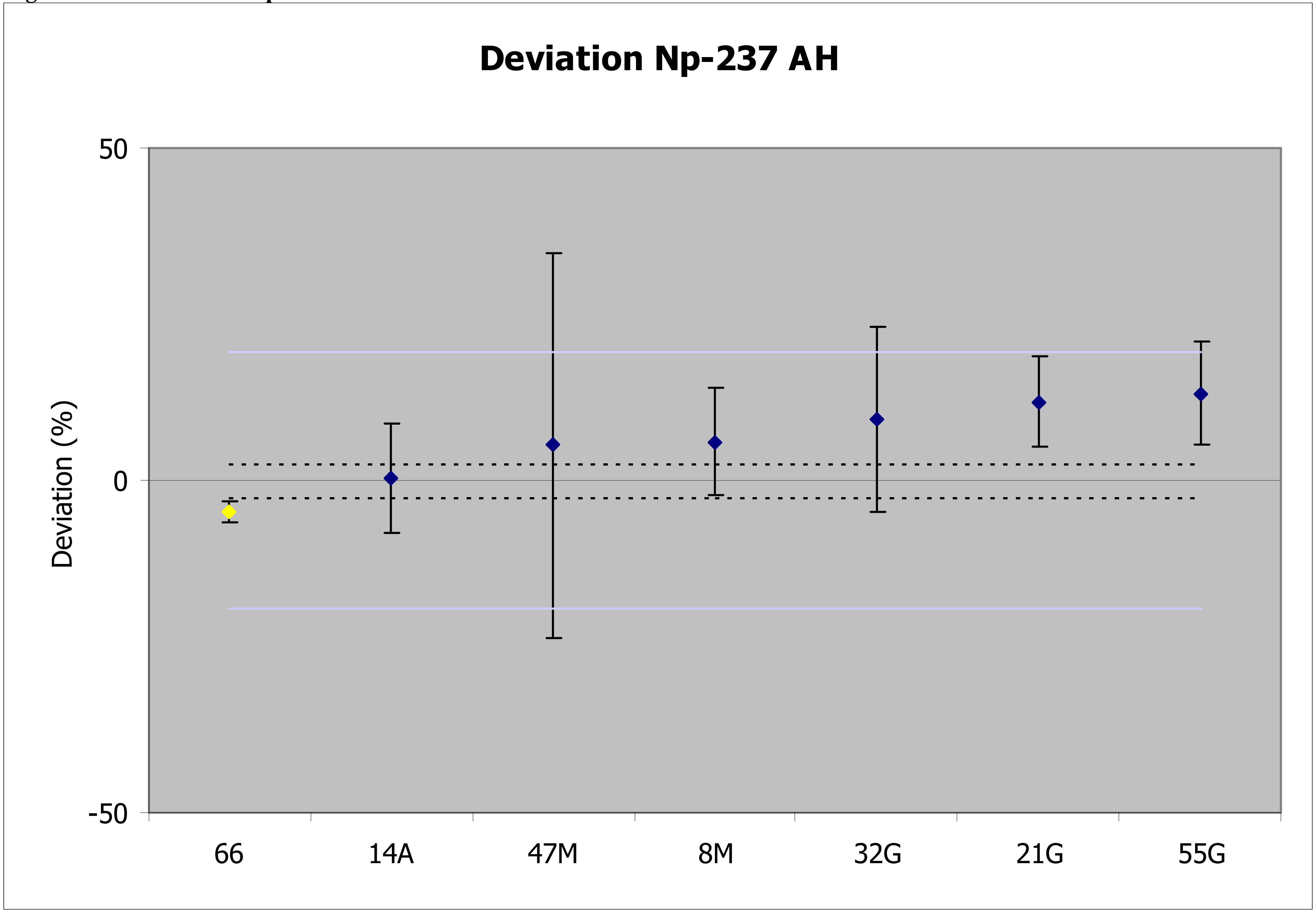


Figure 10B – Zeta score Np-237 AH

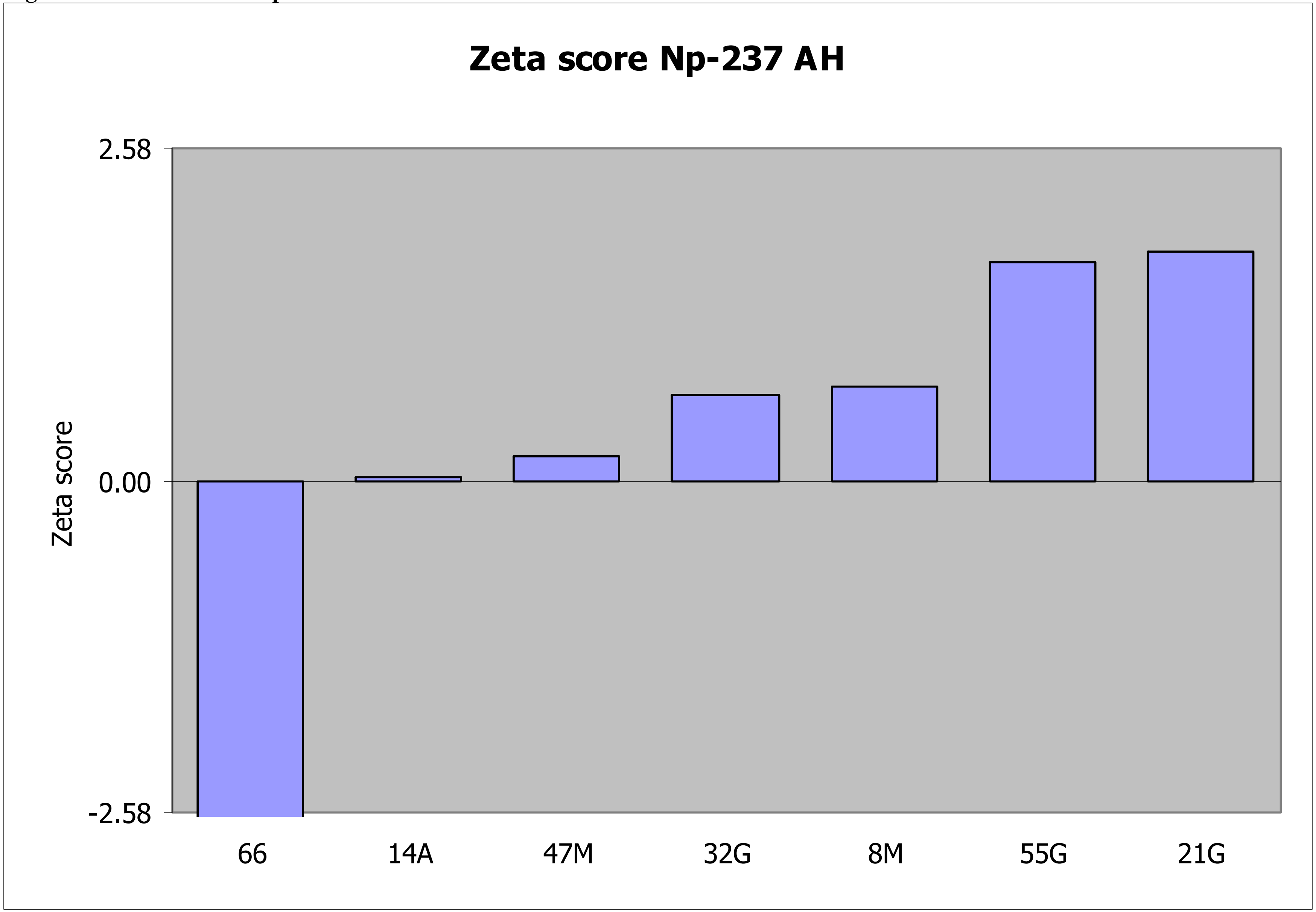


Figure 10C – Relative uncertainty Np-237 AH

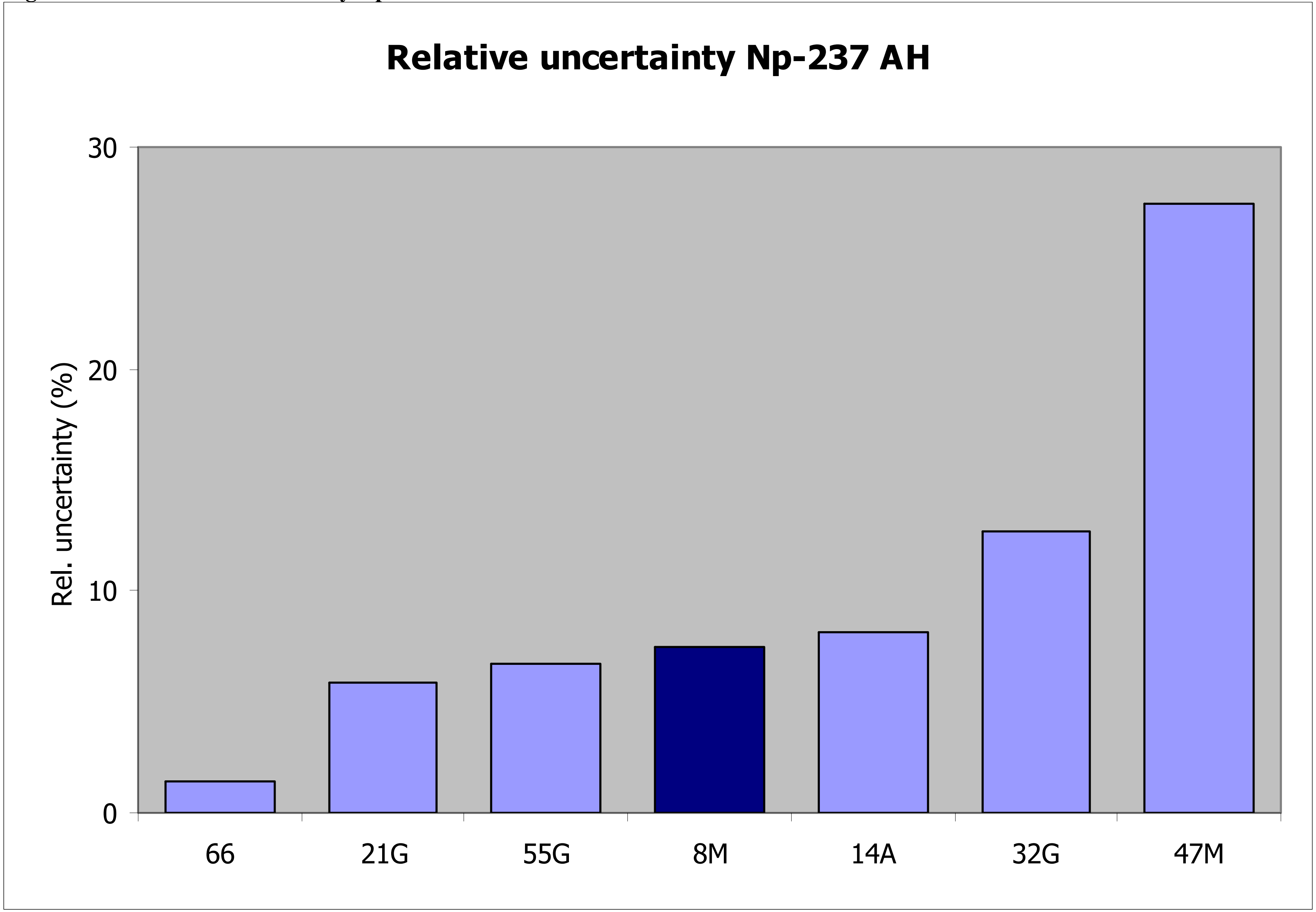


Figure 10D – Kiri plot Np-237 AH

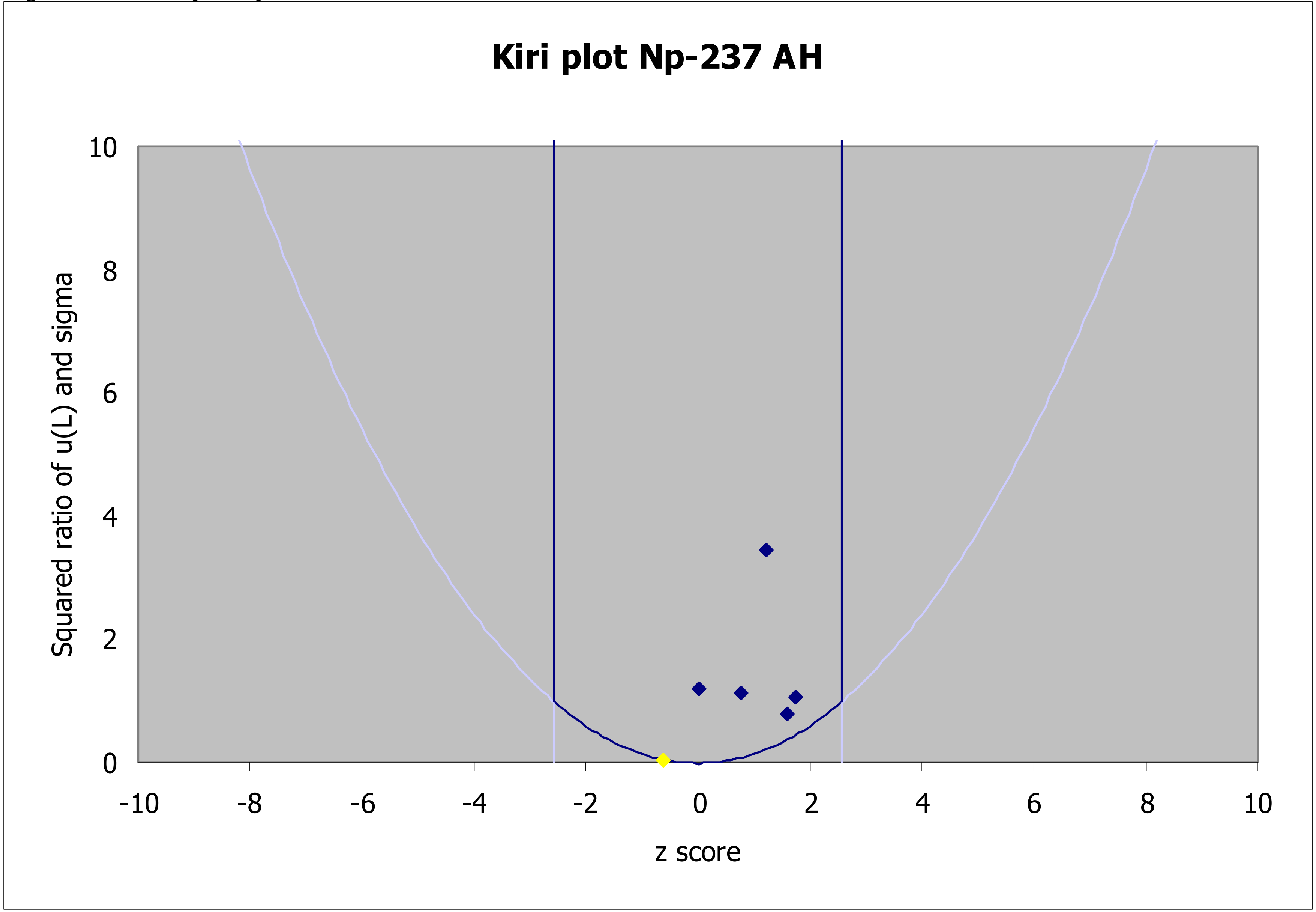


Figure 11A – Deviation U-238 AH

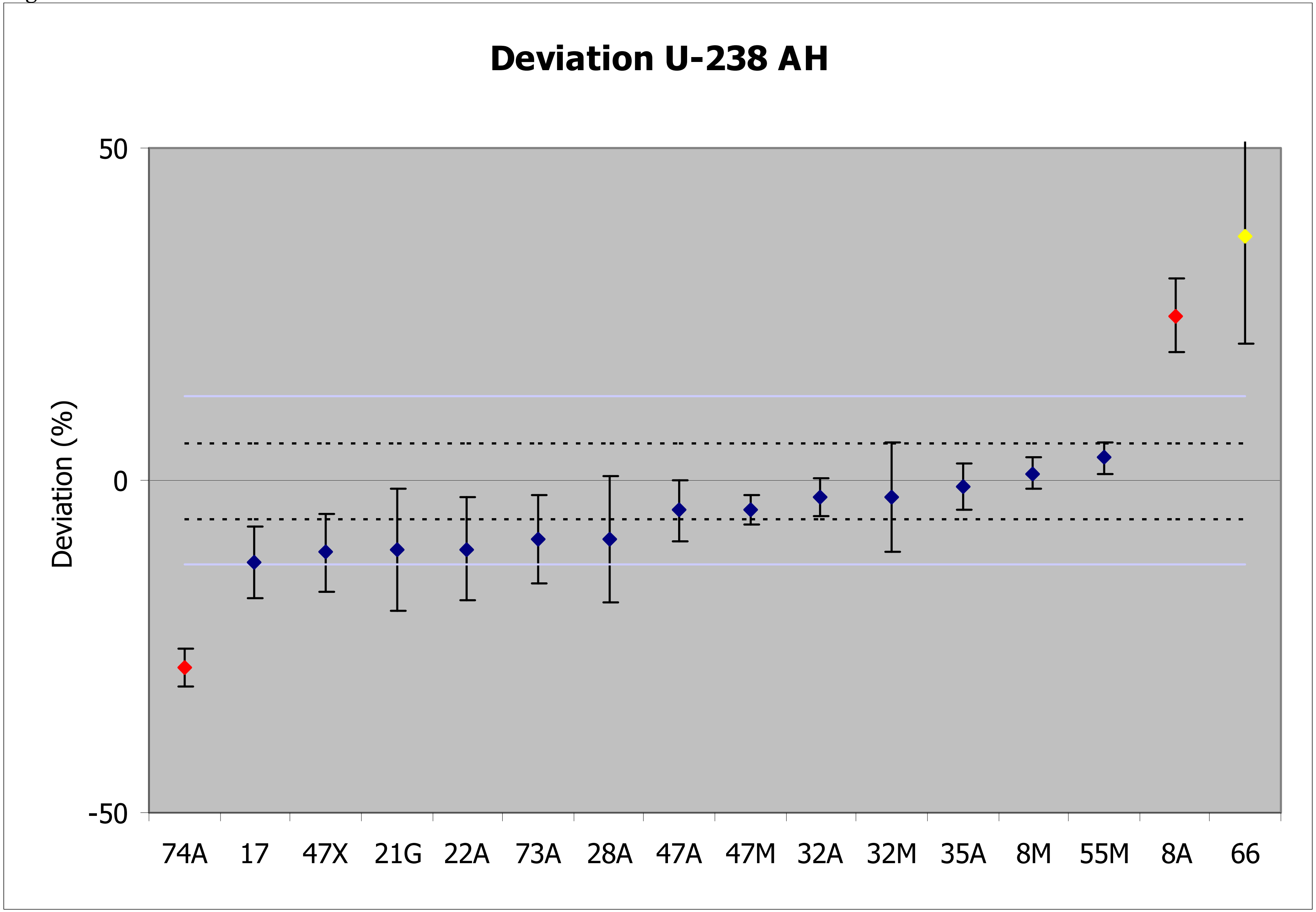


Figure 11B – Zeta score U-238 AH

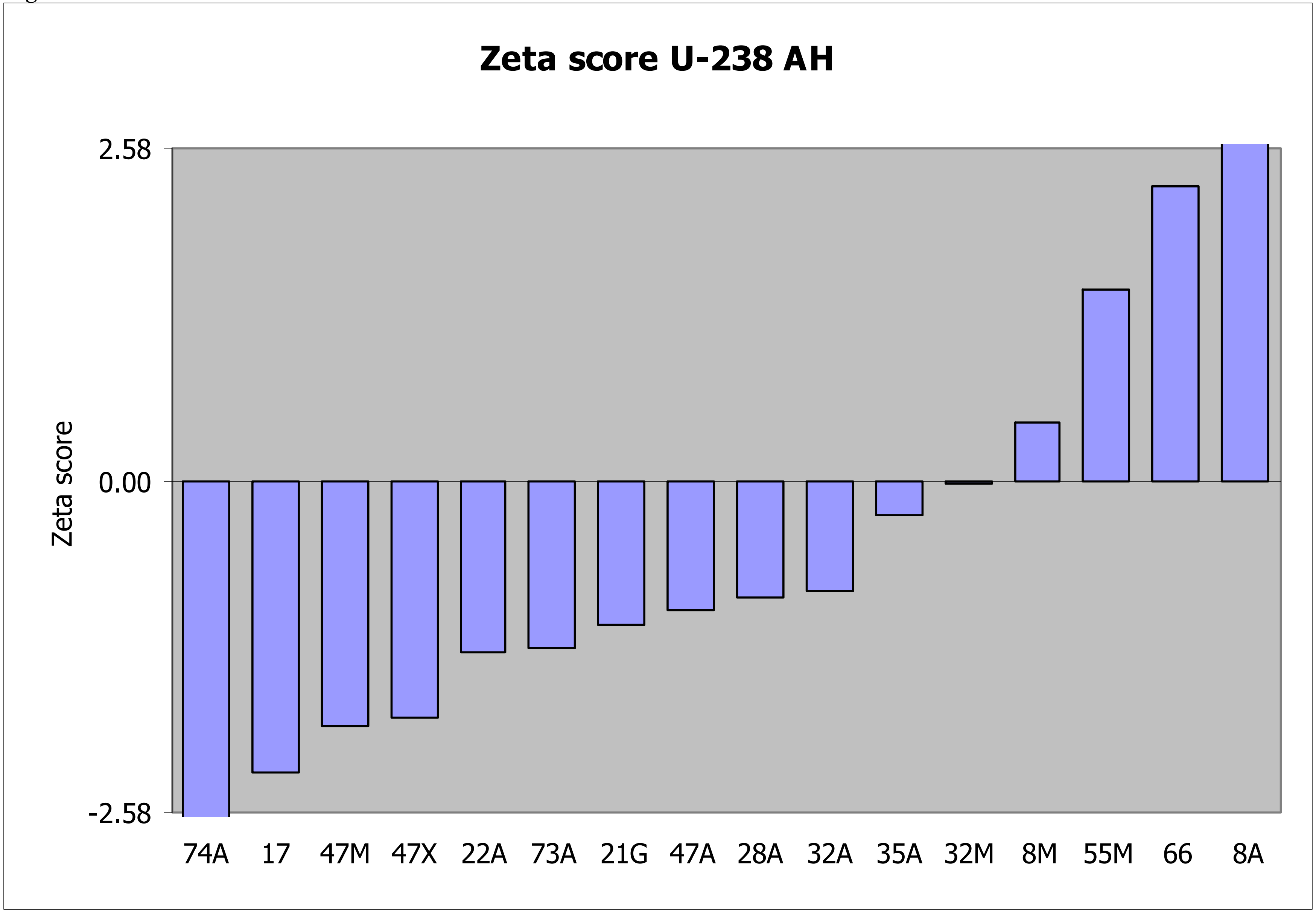


Figure 11C – Relative uncertainty U-238 AH

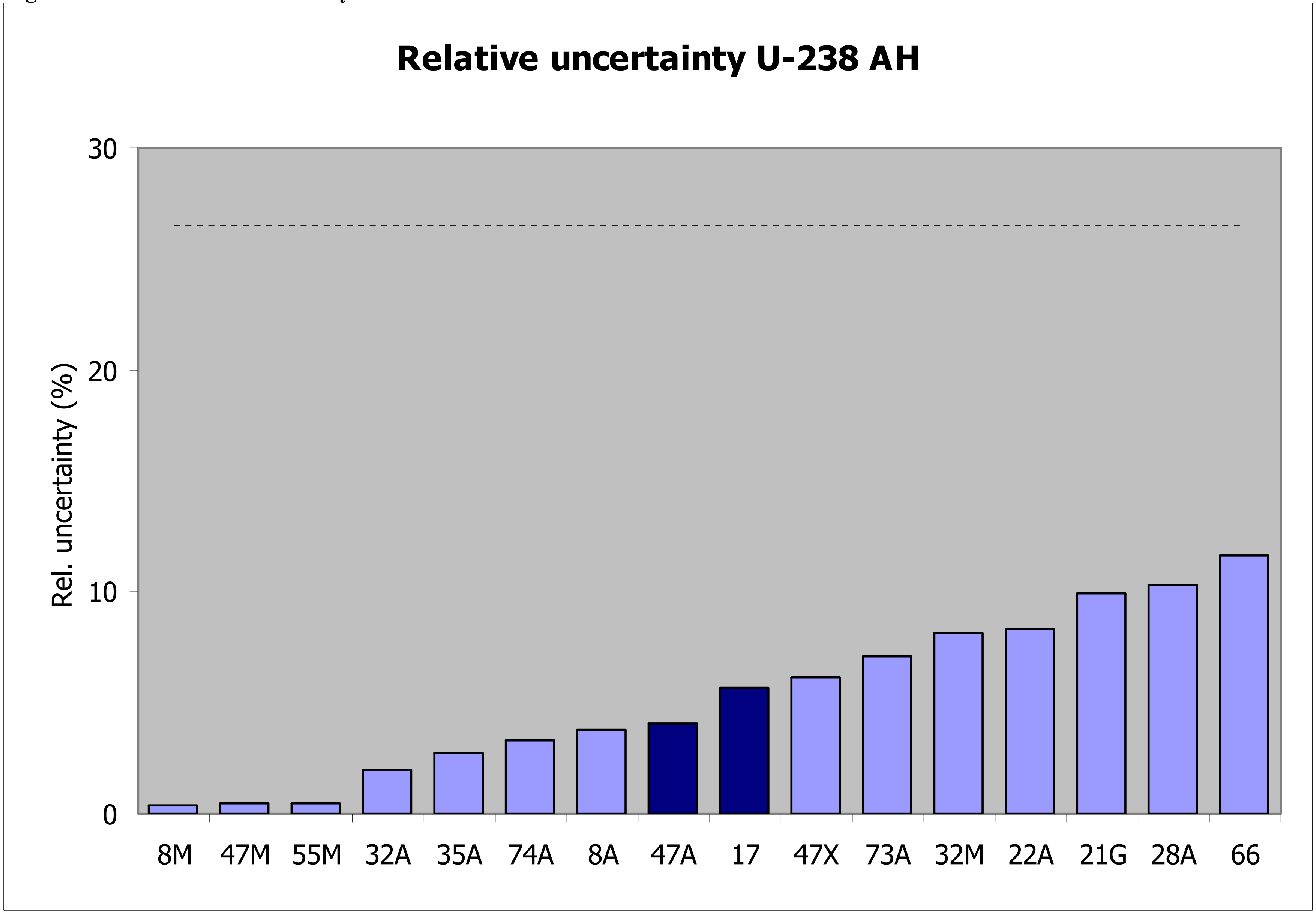


Figure 11D – Kiri plot U-238 AH

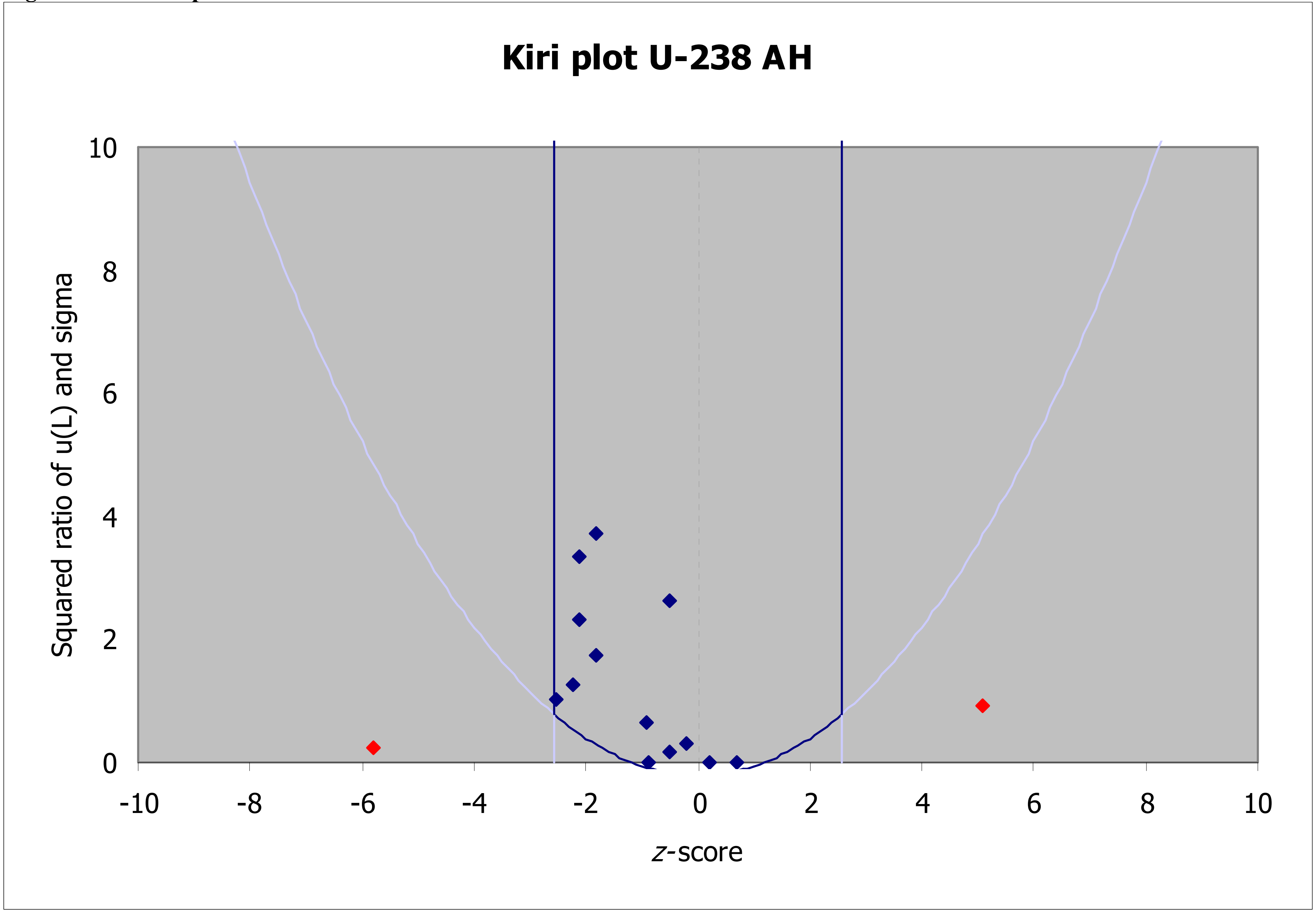


Figure 12A – Deviation Pu-238 AH

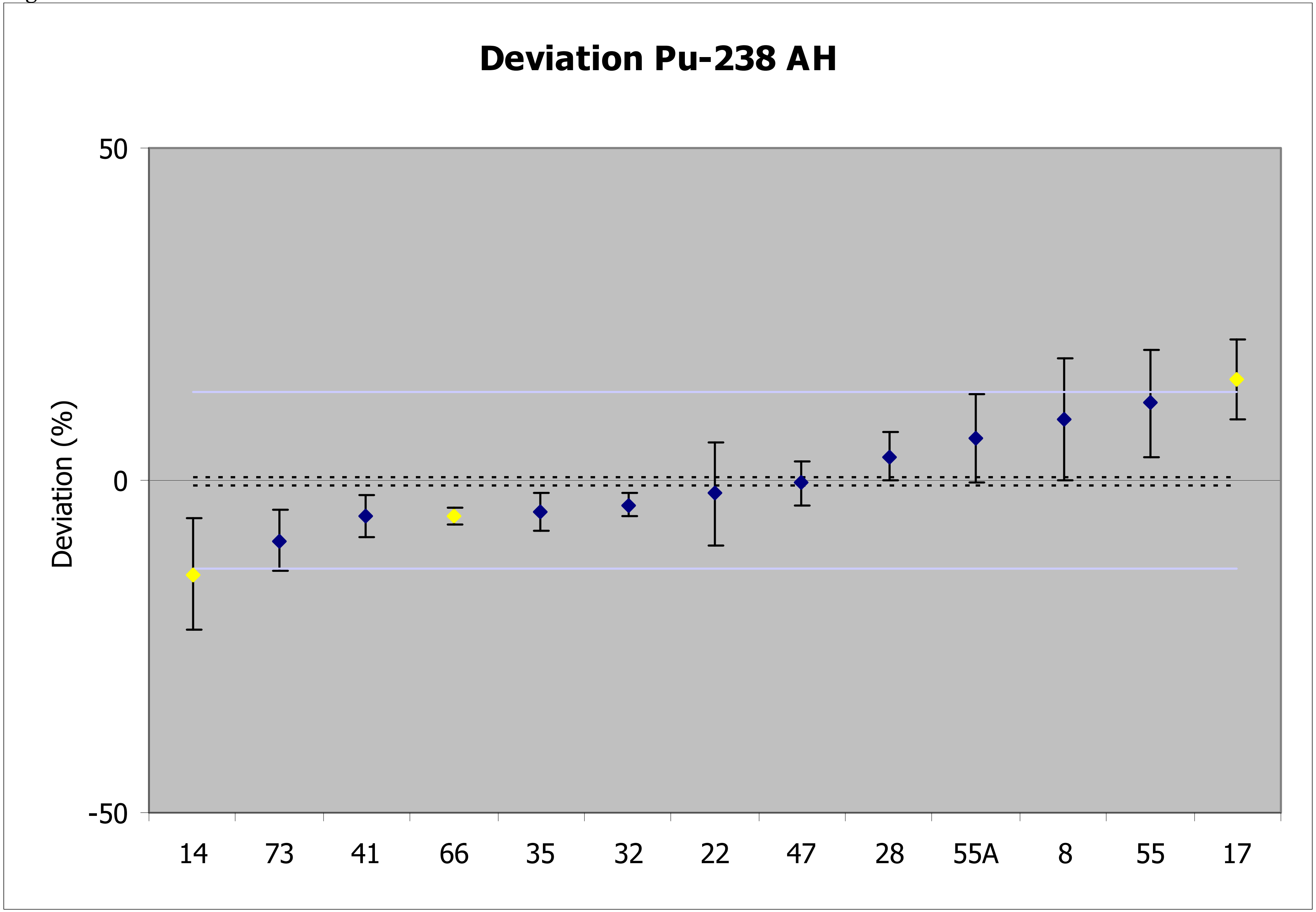


Figure 12B – Zeta score Pu-238 AH

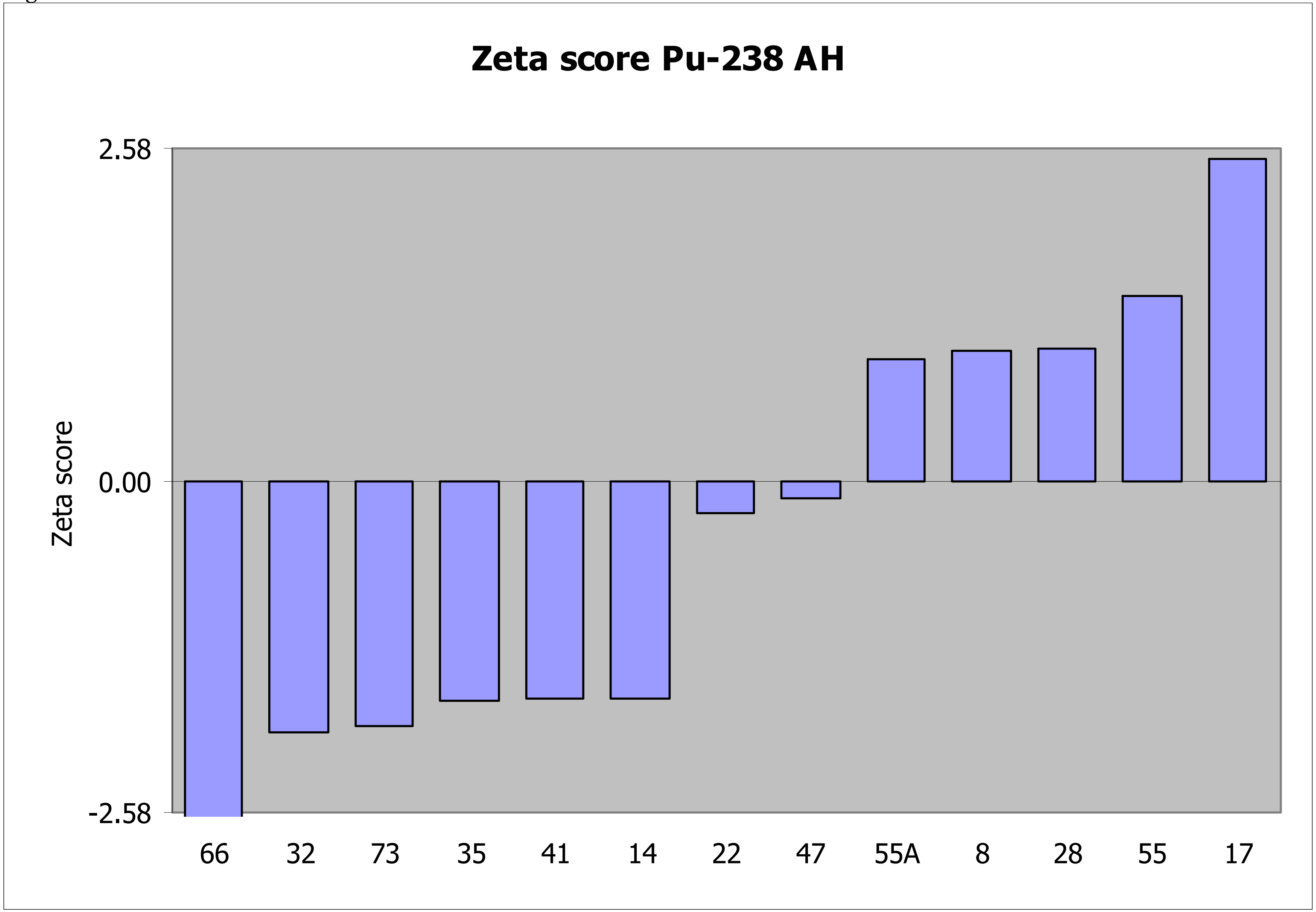


Figure 12C – Relative uncertainty Pu-238 AH

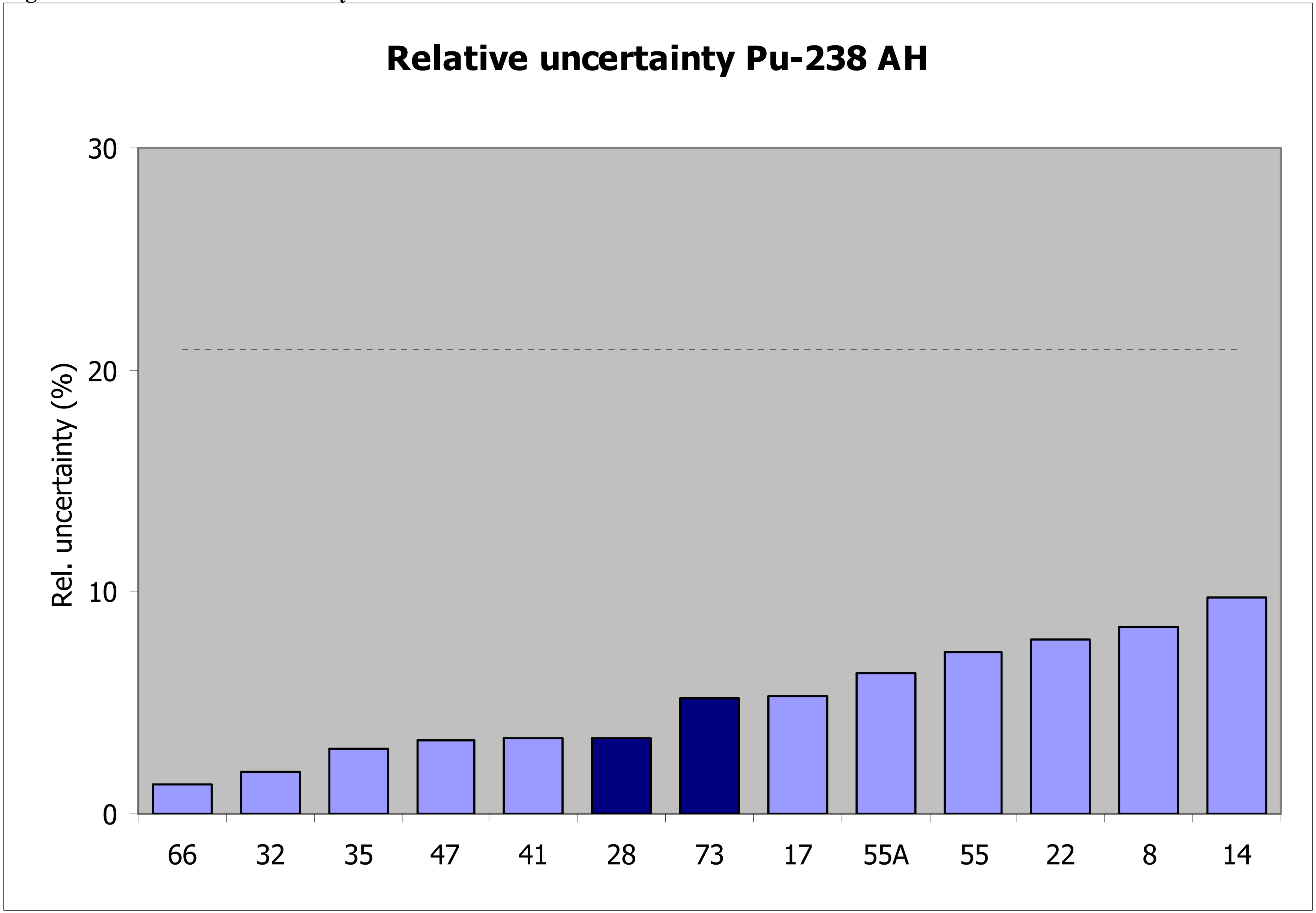


Figure 12D – Kiri plot Pu-238 AH

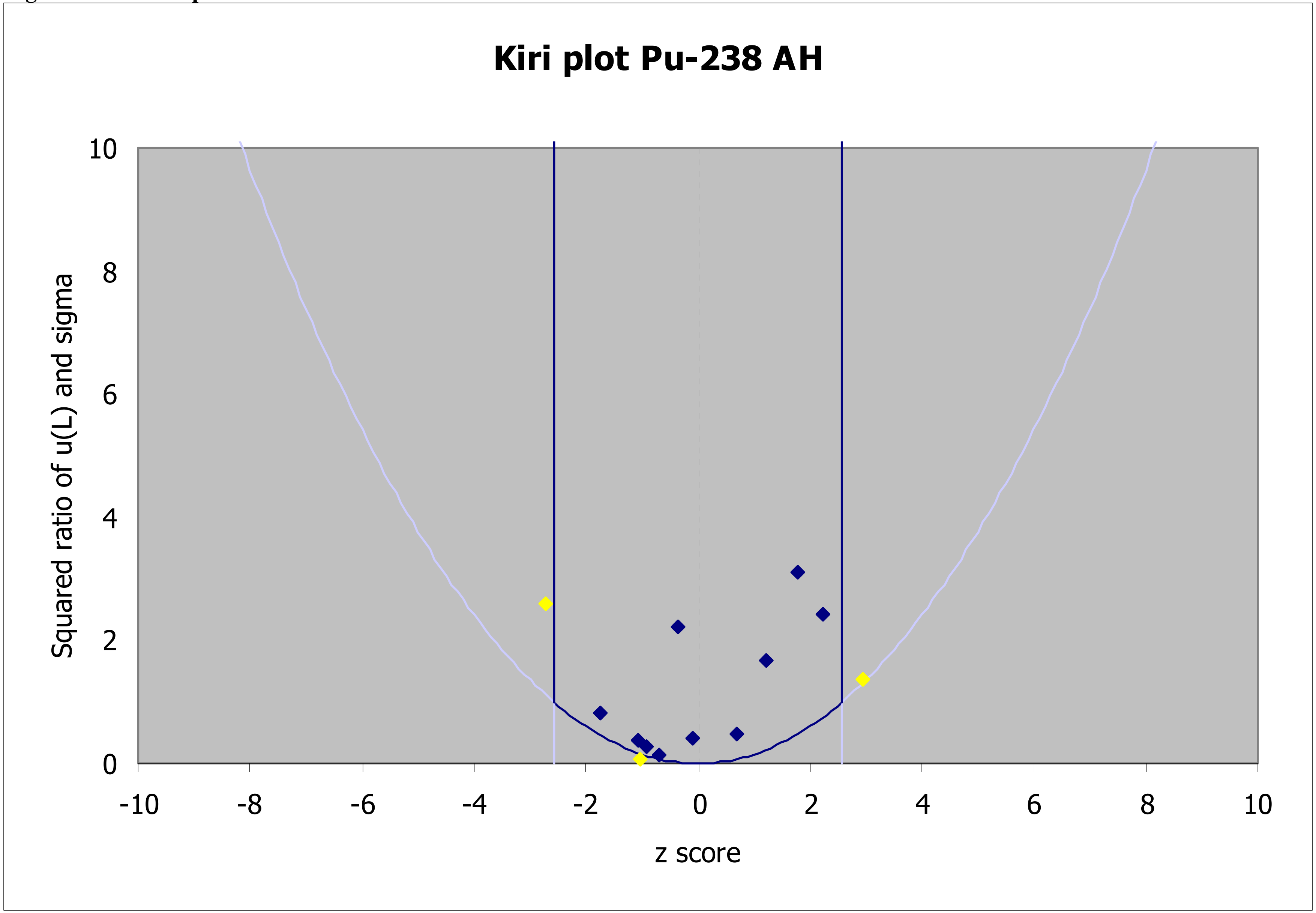


Figure 13A – Deviation Pu-239 AH

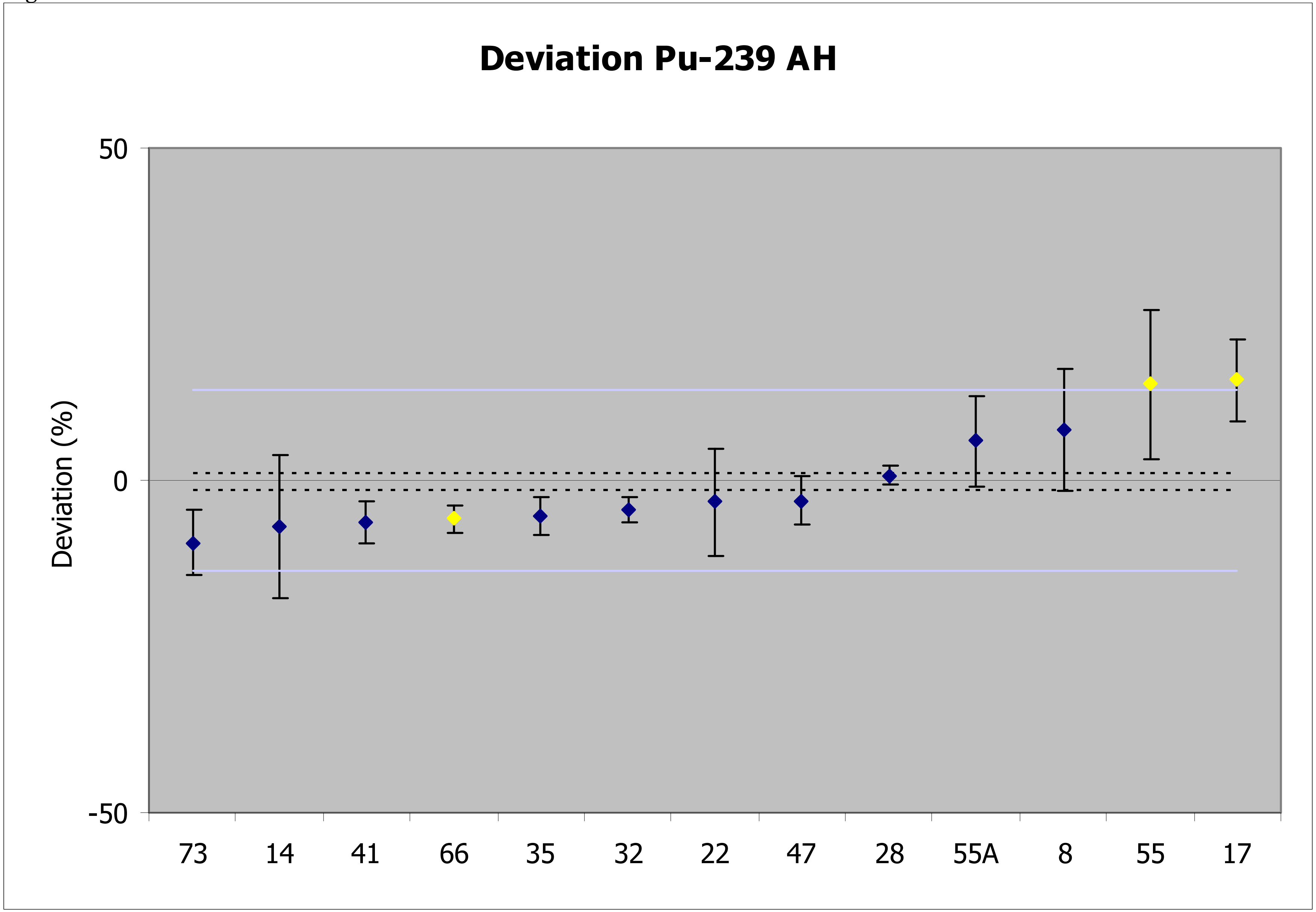


Figure 13B – Zeta score Pu-239 AH

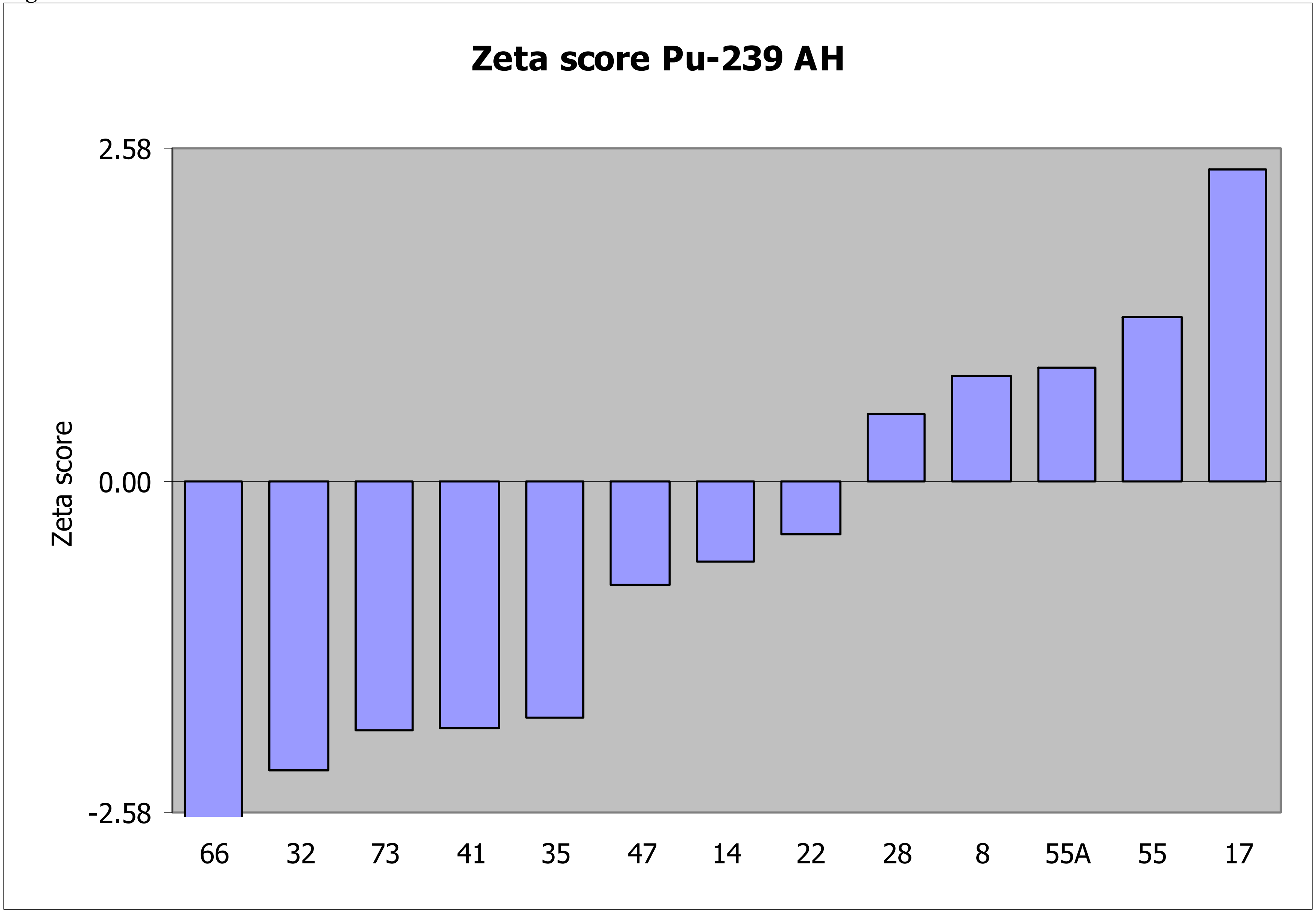


Figure 13C – Relative uncertainty Pu-239 AH

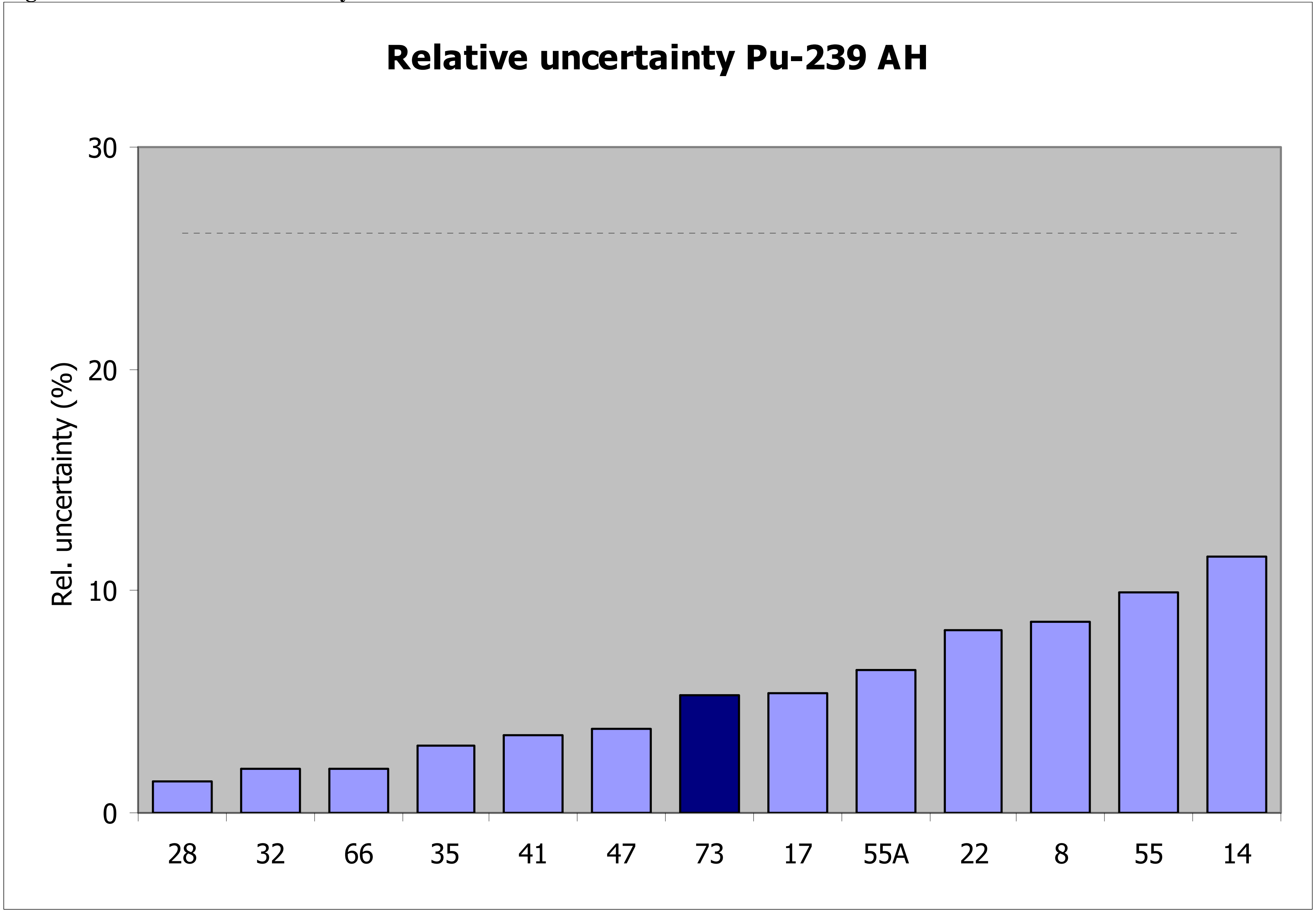


Figure 13D – Kiri plot Pu-239 AH

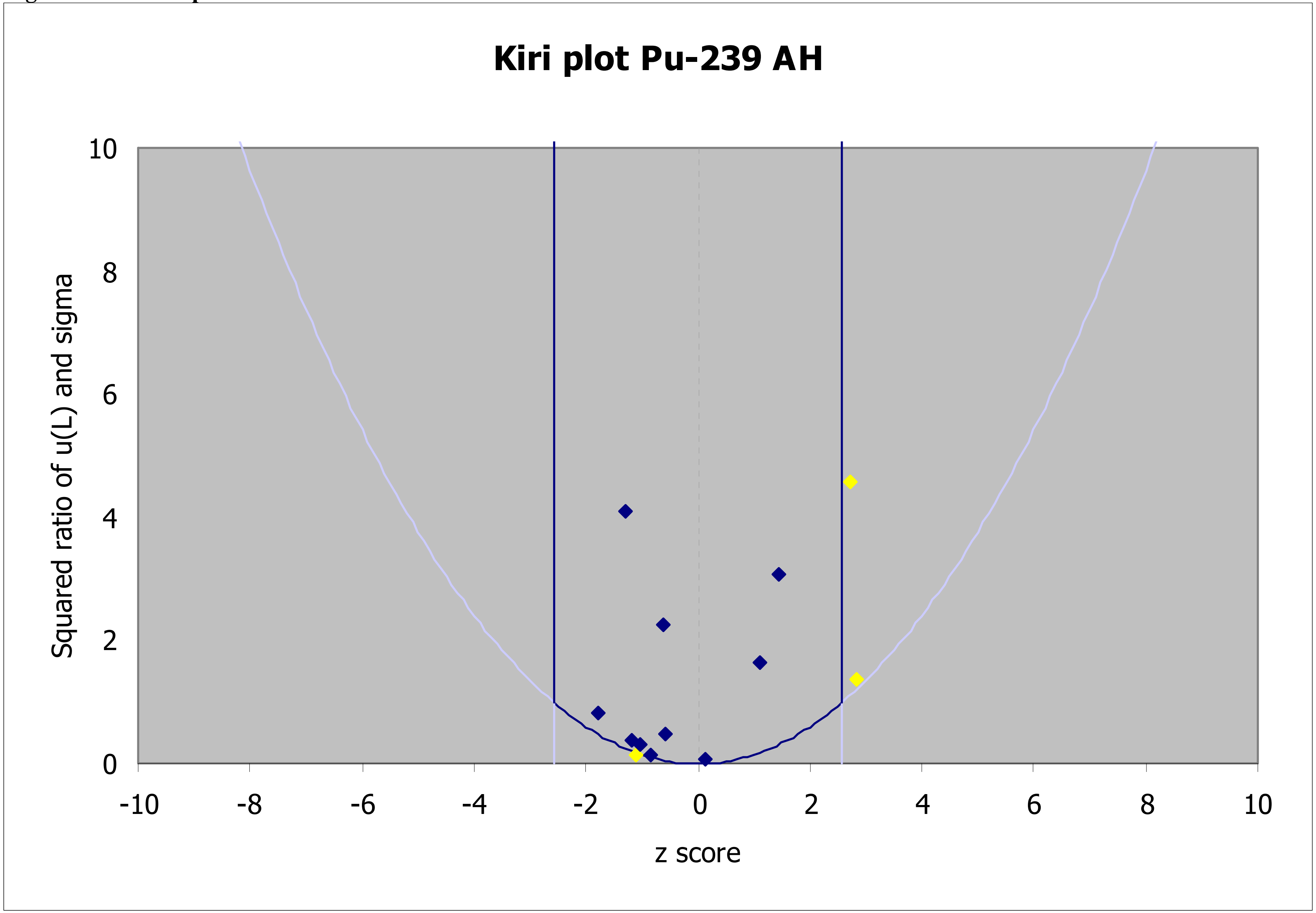


Figure 14A – Deviation Am-241 AH

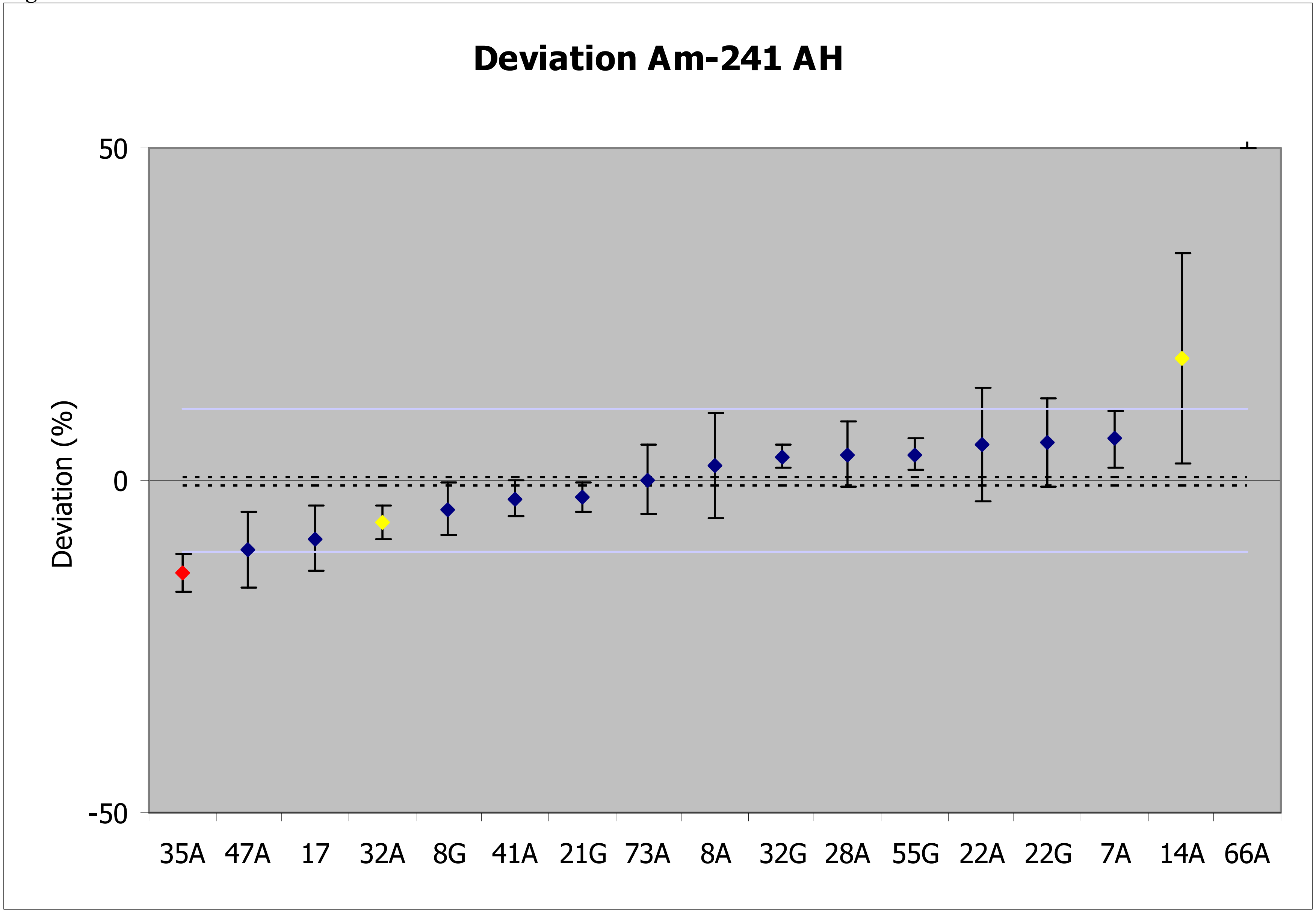


Figure 14B – Zeta score Am-241 AH

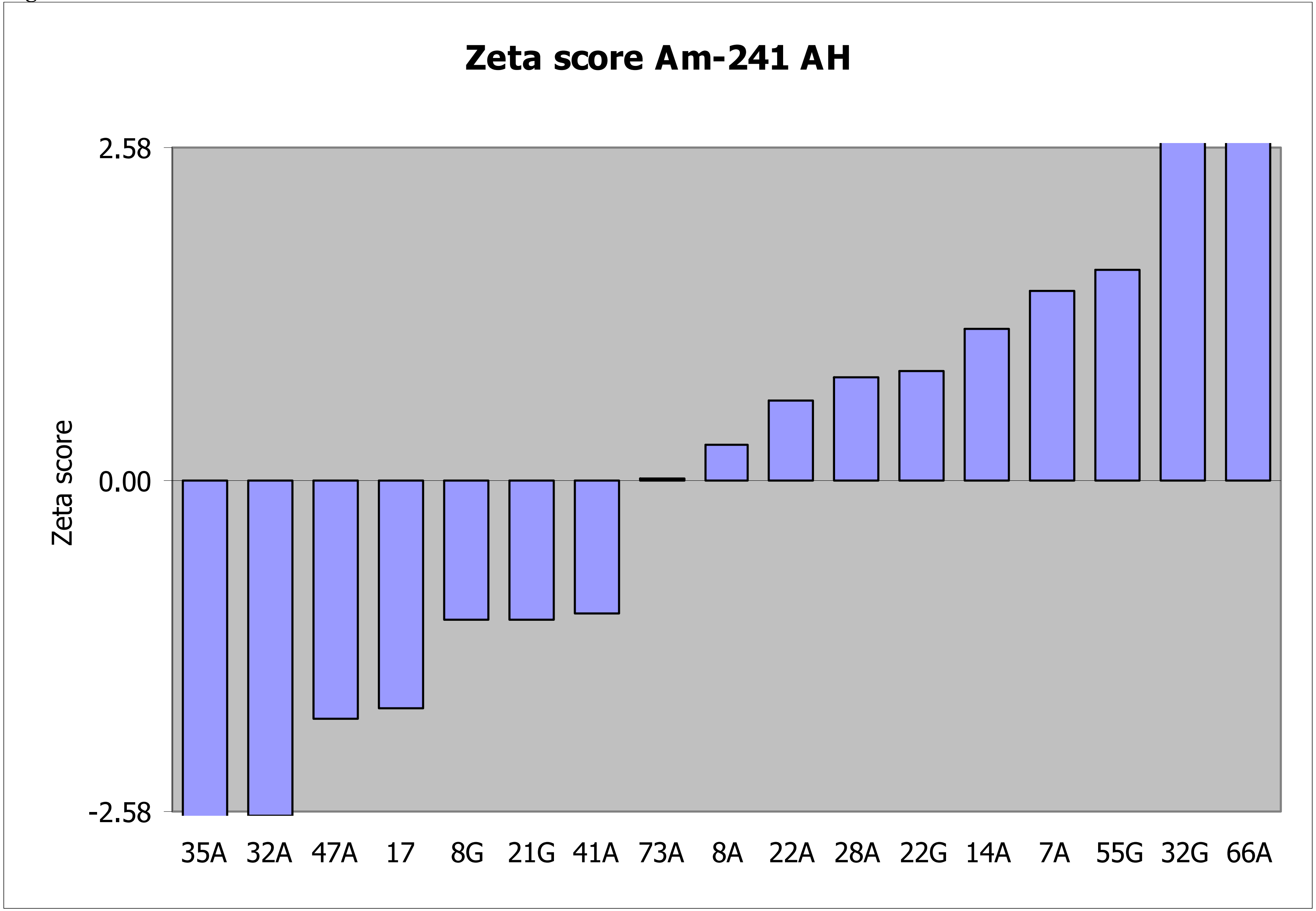


Figure 14C – Relative uncertainty Am-241 AH

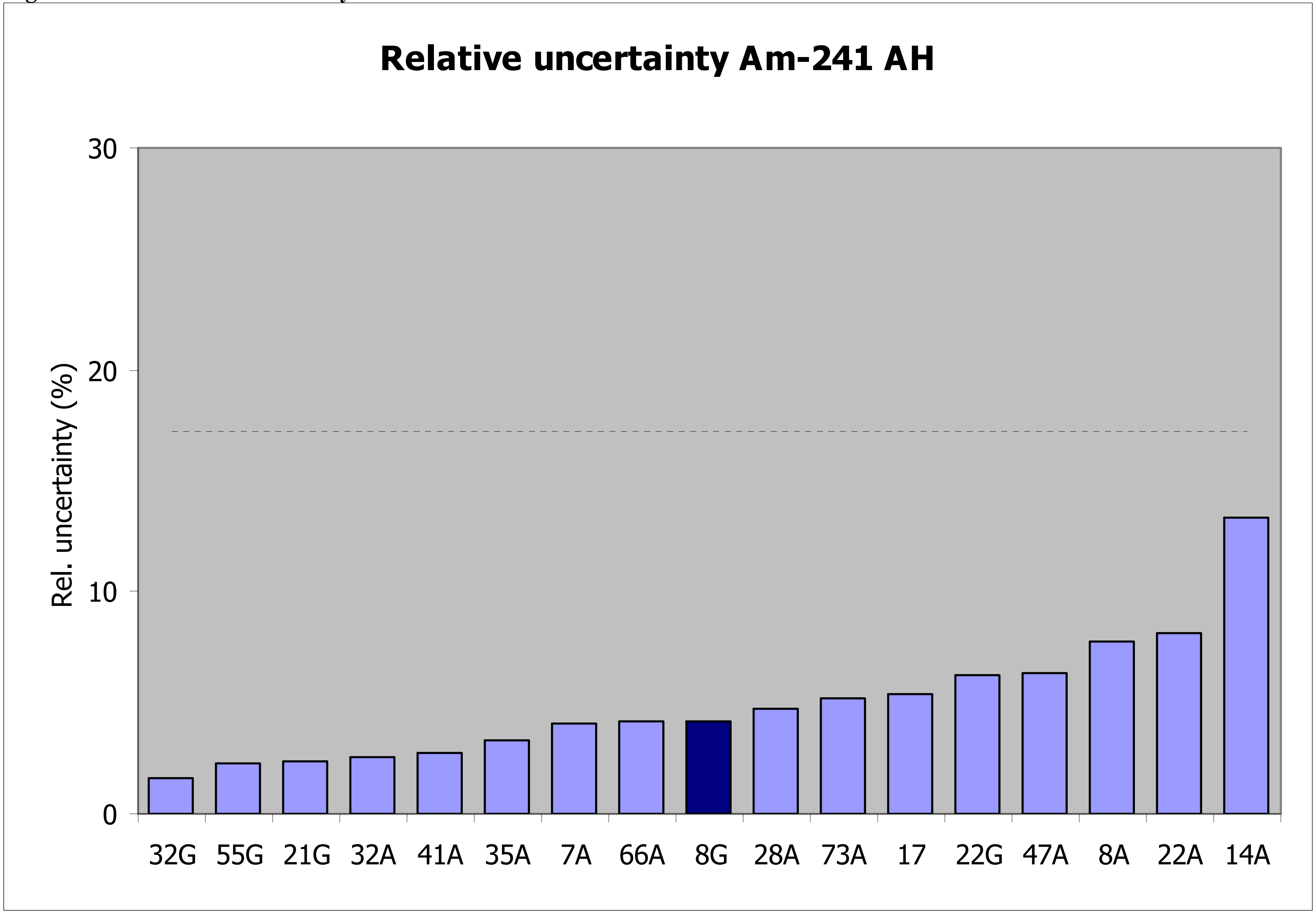


Figure 14D – Kiri plot Am-241 AH

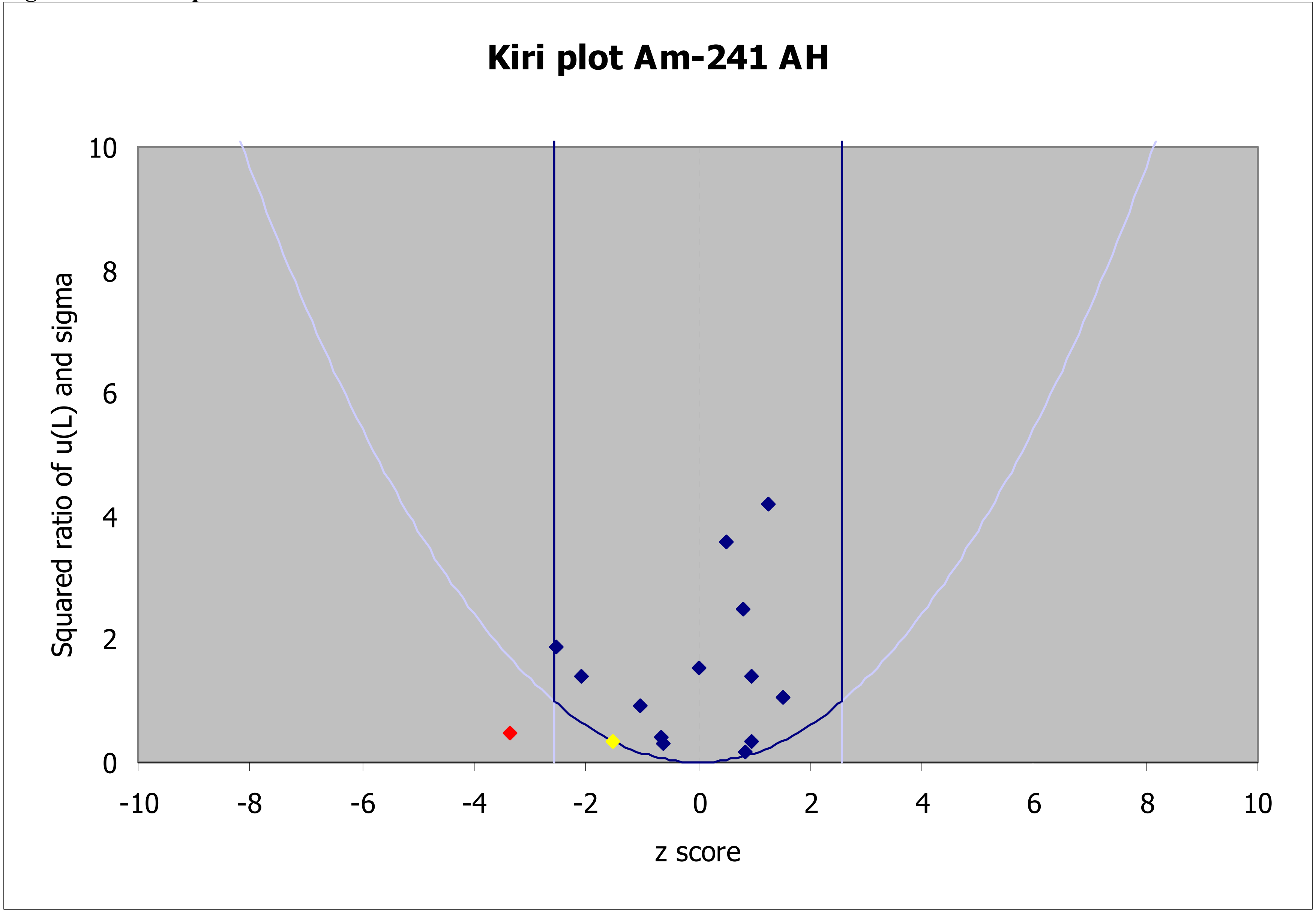


Figure 15A – Deviation Cm-244 AH

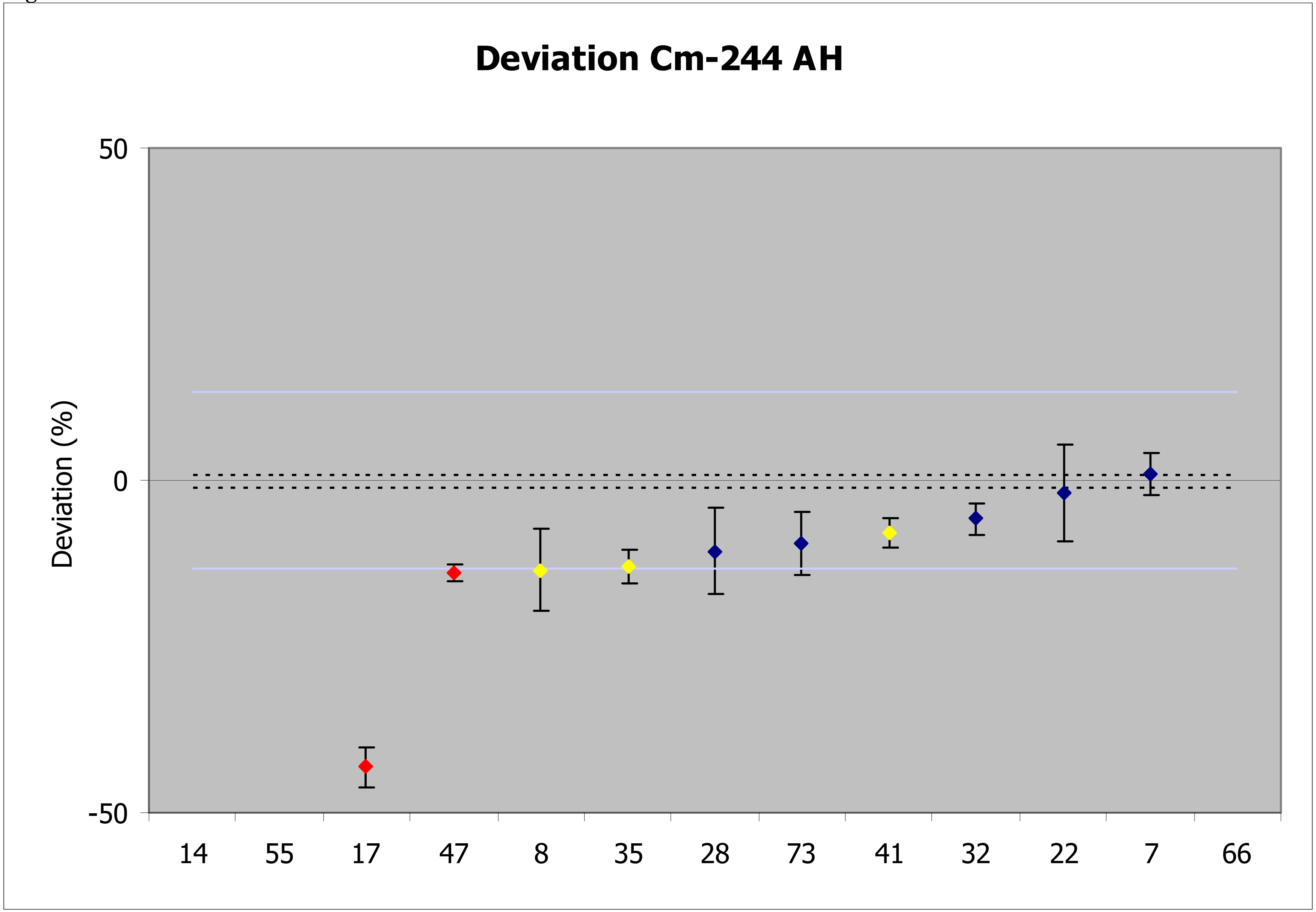


Figure 15B – Zeta score Cm-244 AH

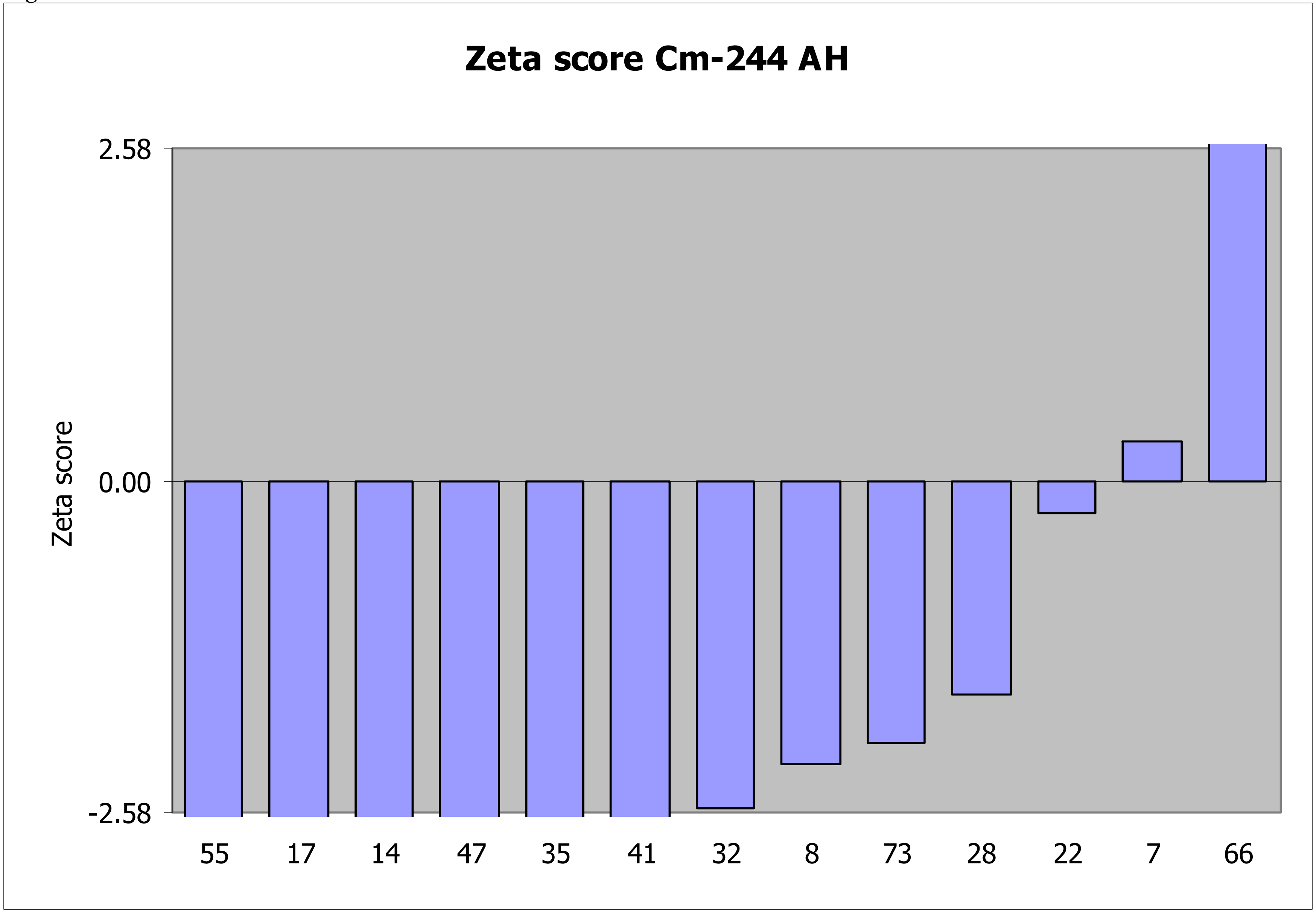


Figure 15C – Relative uncertainty Cm-244 AH

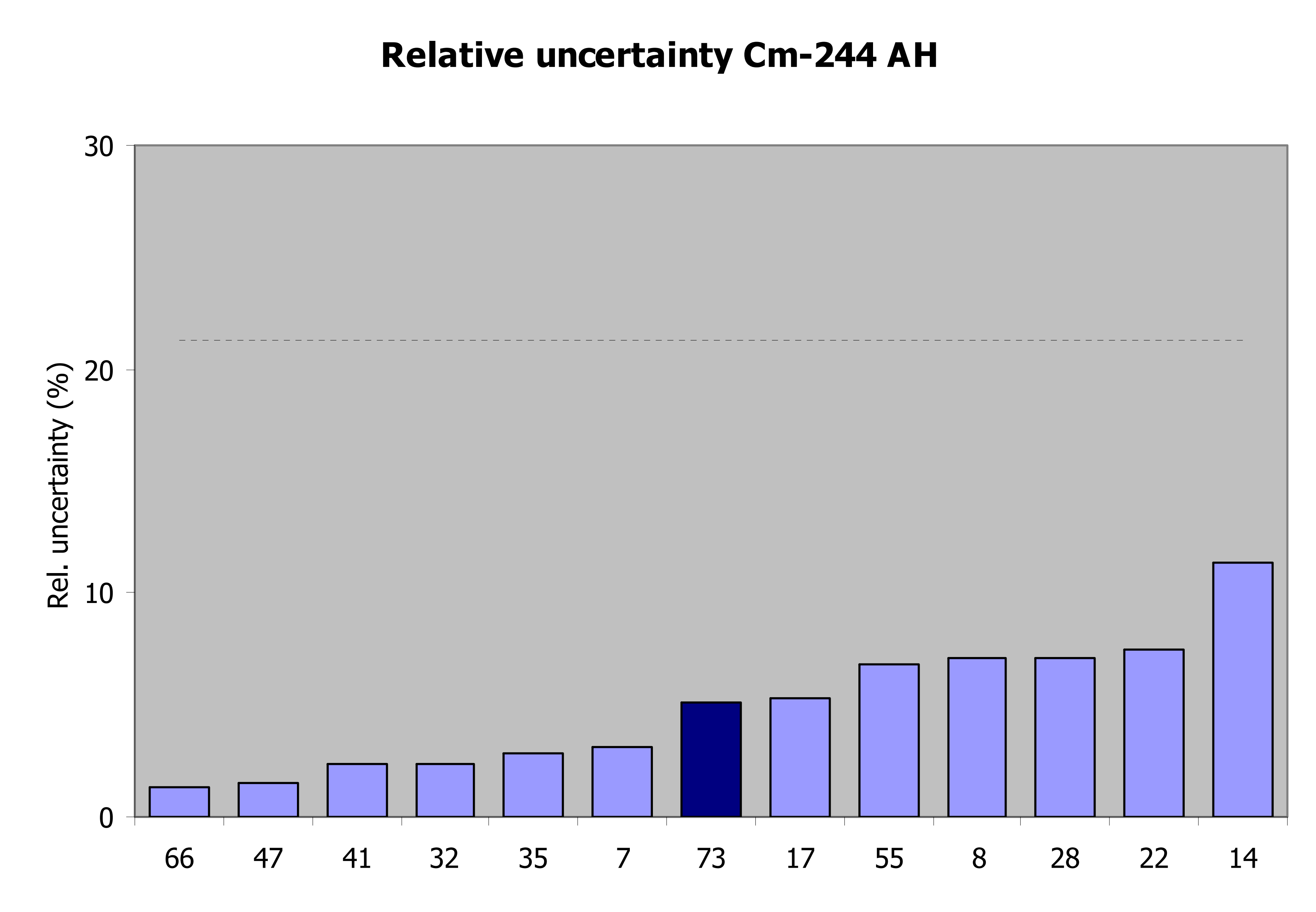


Figure 15D – Kiri plot Cm-244 AH

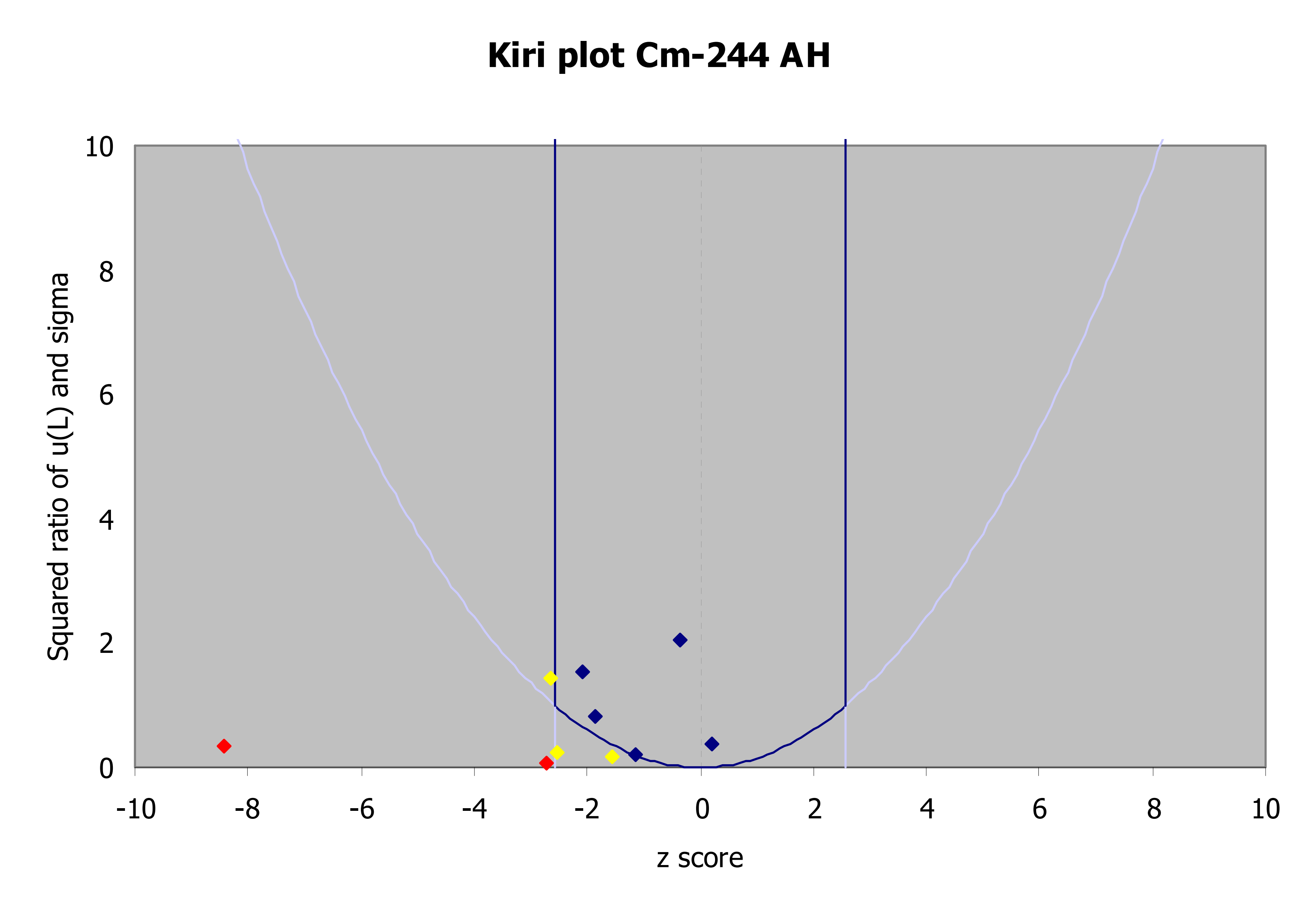


Figure 16A – Deviation gross alpha AH

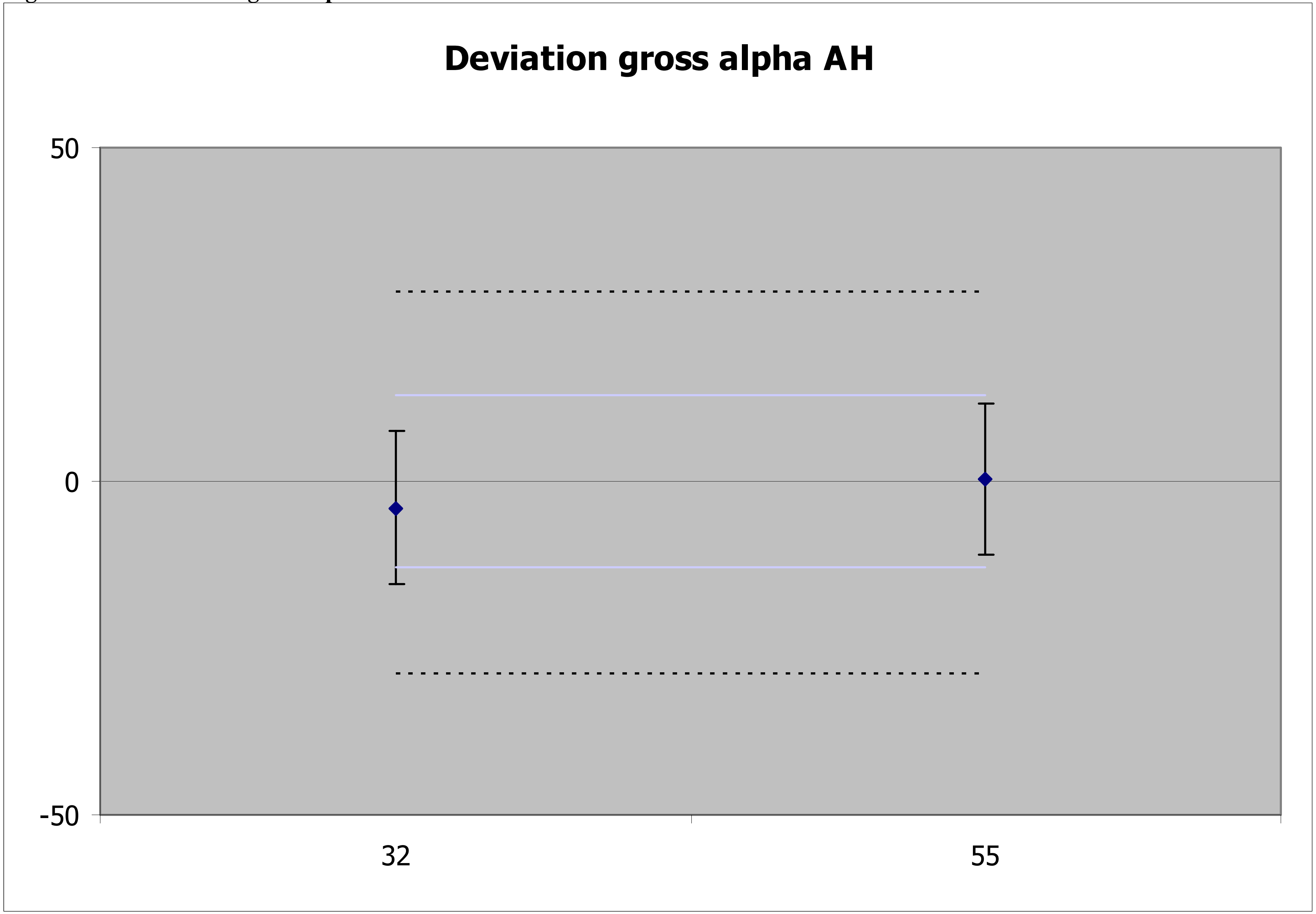


Figure 16B – Zeta score gross alpha AH

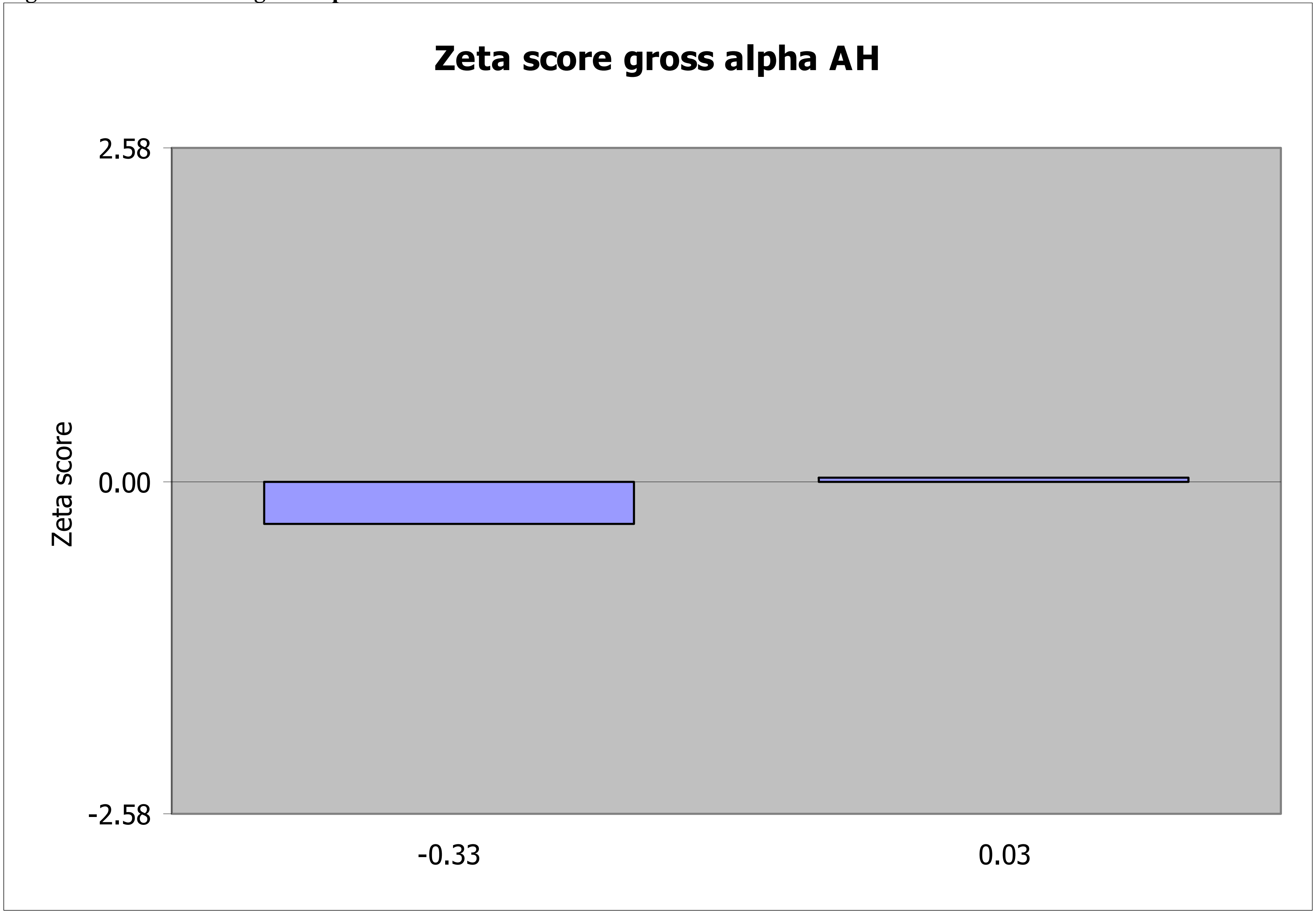


Figure 16C – Relative uncertainty gross alpha AH

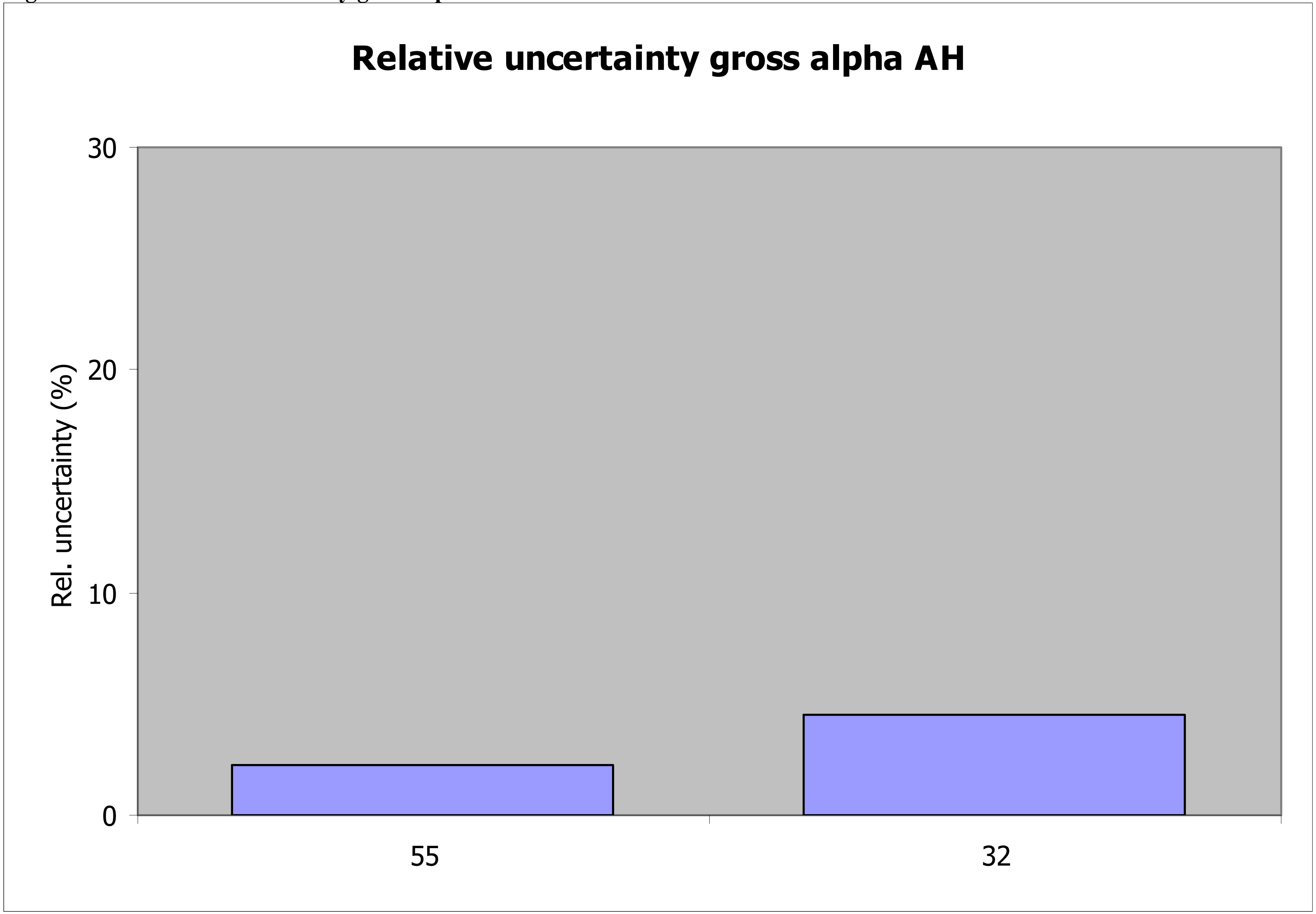


Figure 16D – Kiri plot gross alpha AH

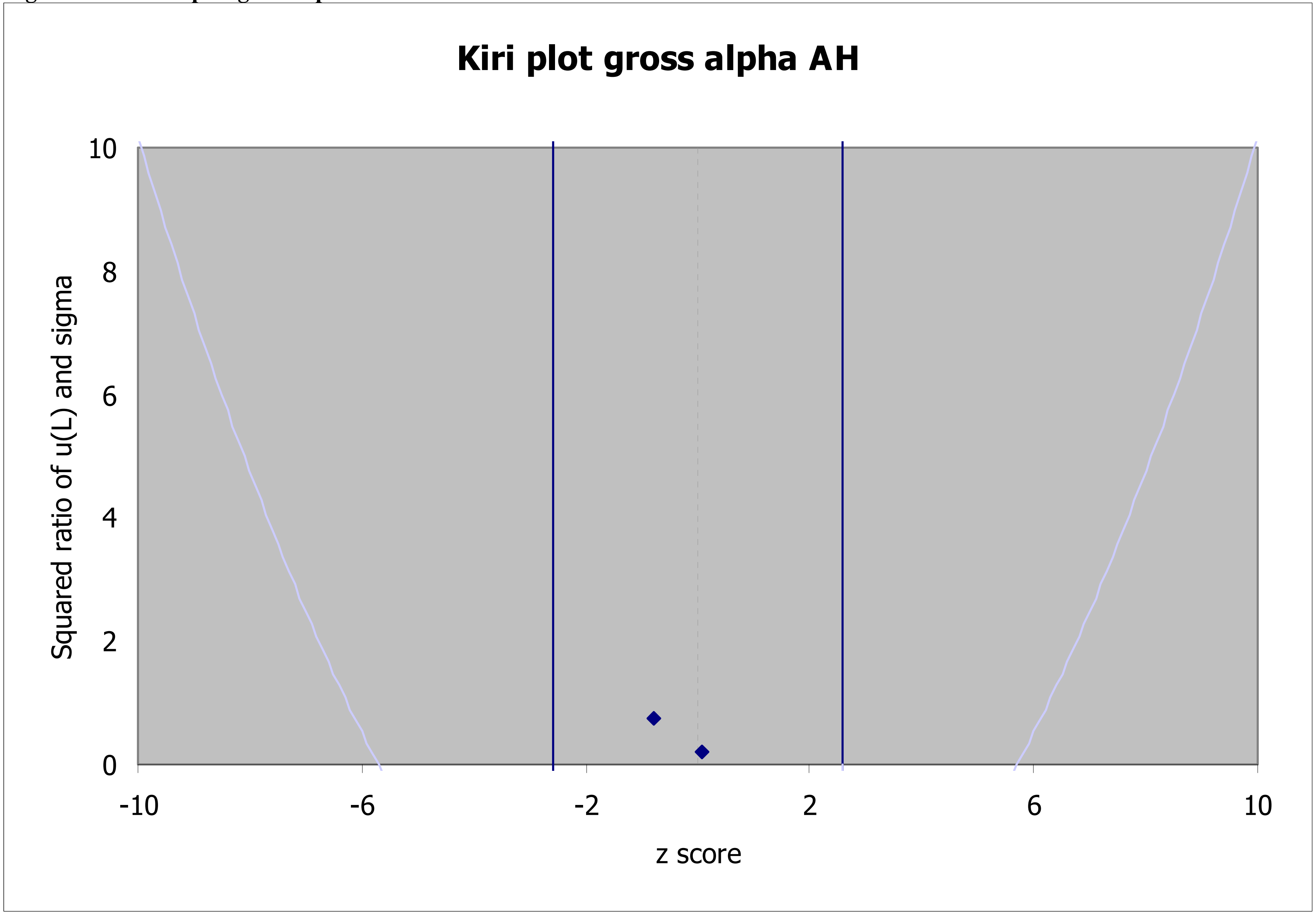


Figure 17A – Deviation H-3 BL

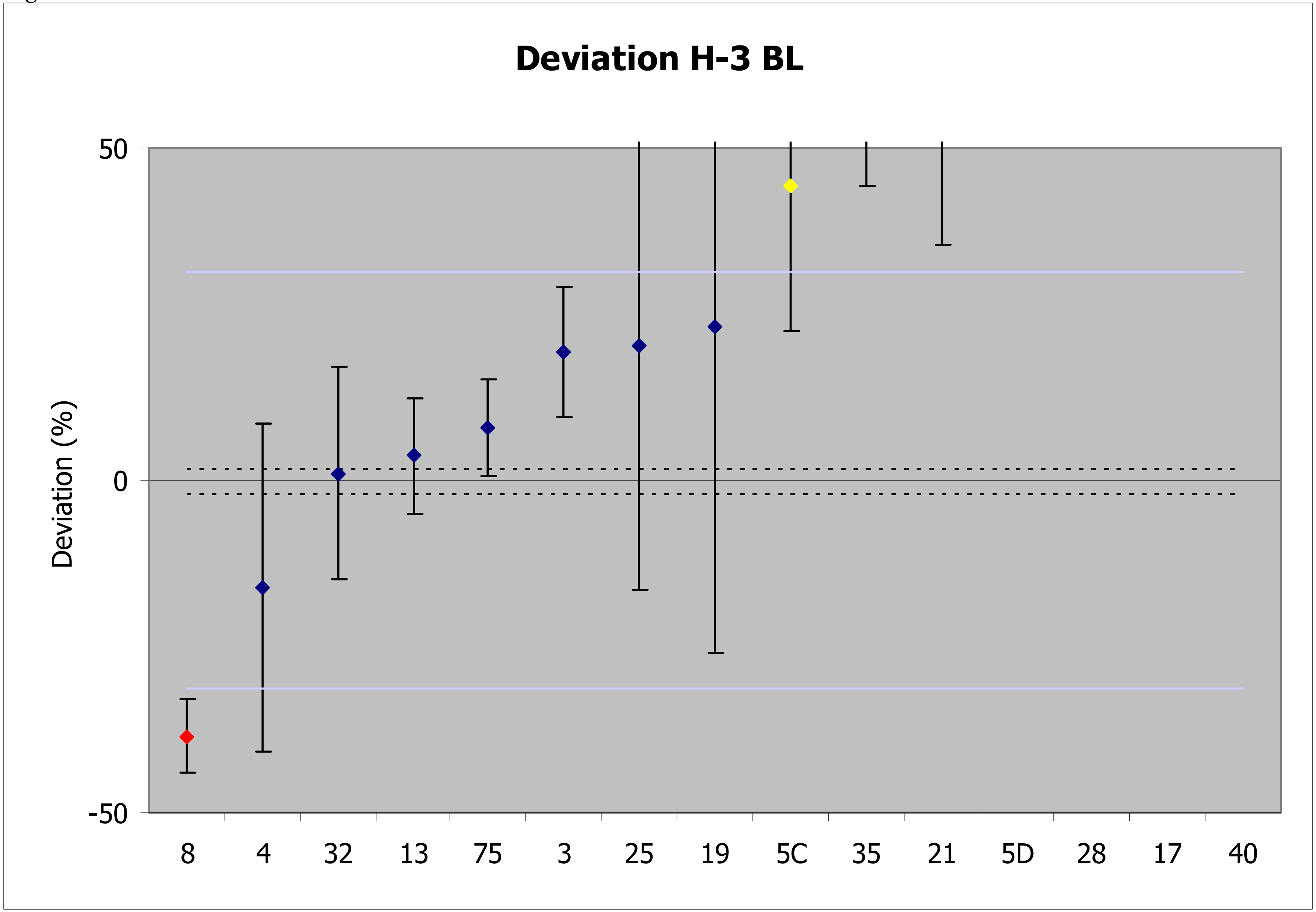


Figure 17B – Zeta score H-3 BL

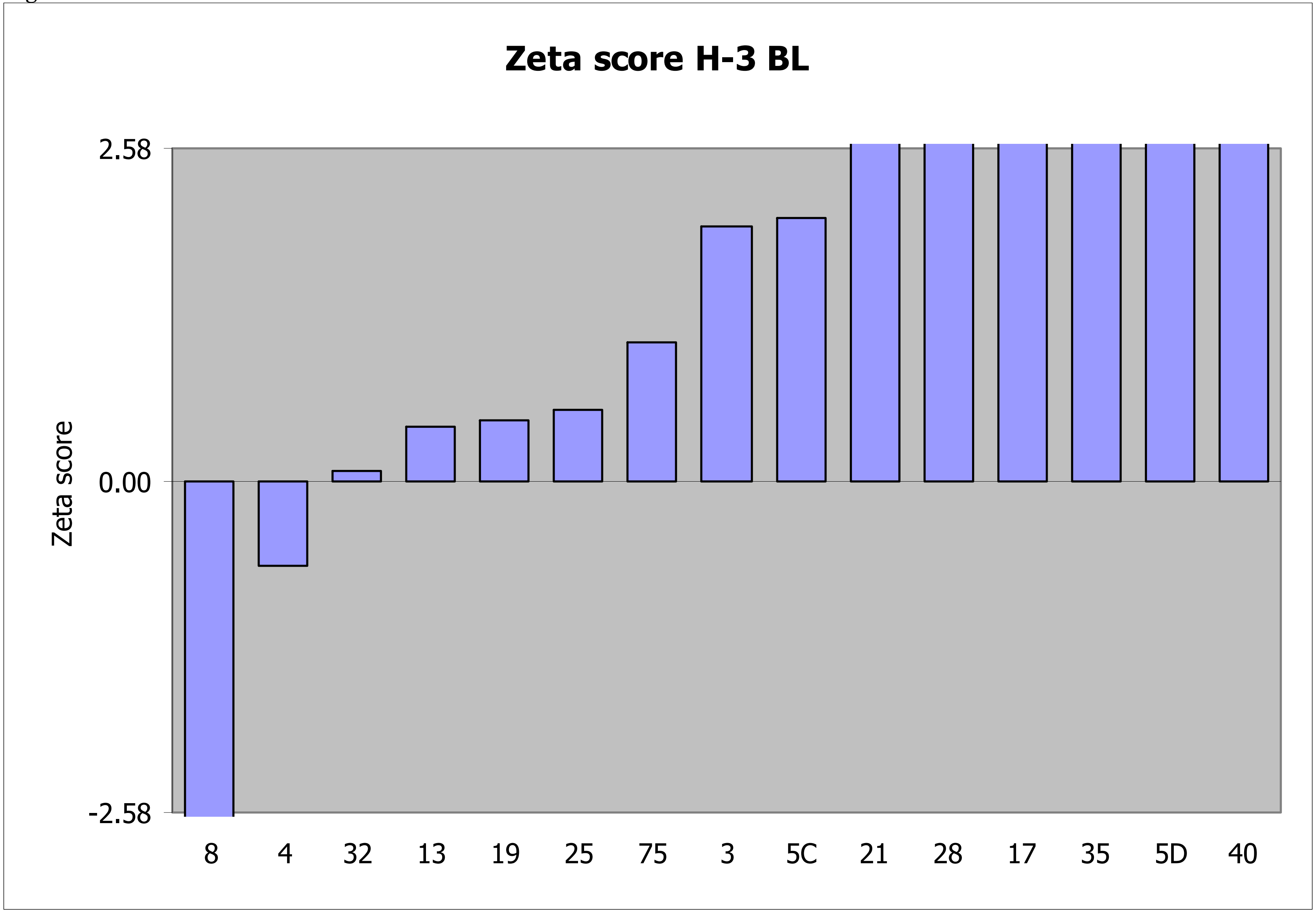


Figure 17C – Relative uncertainty H-3 BL

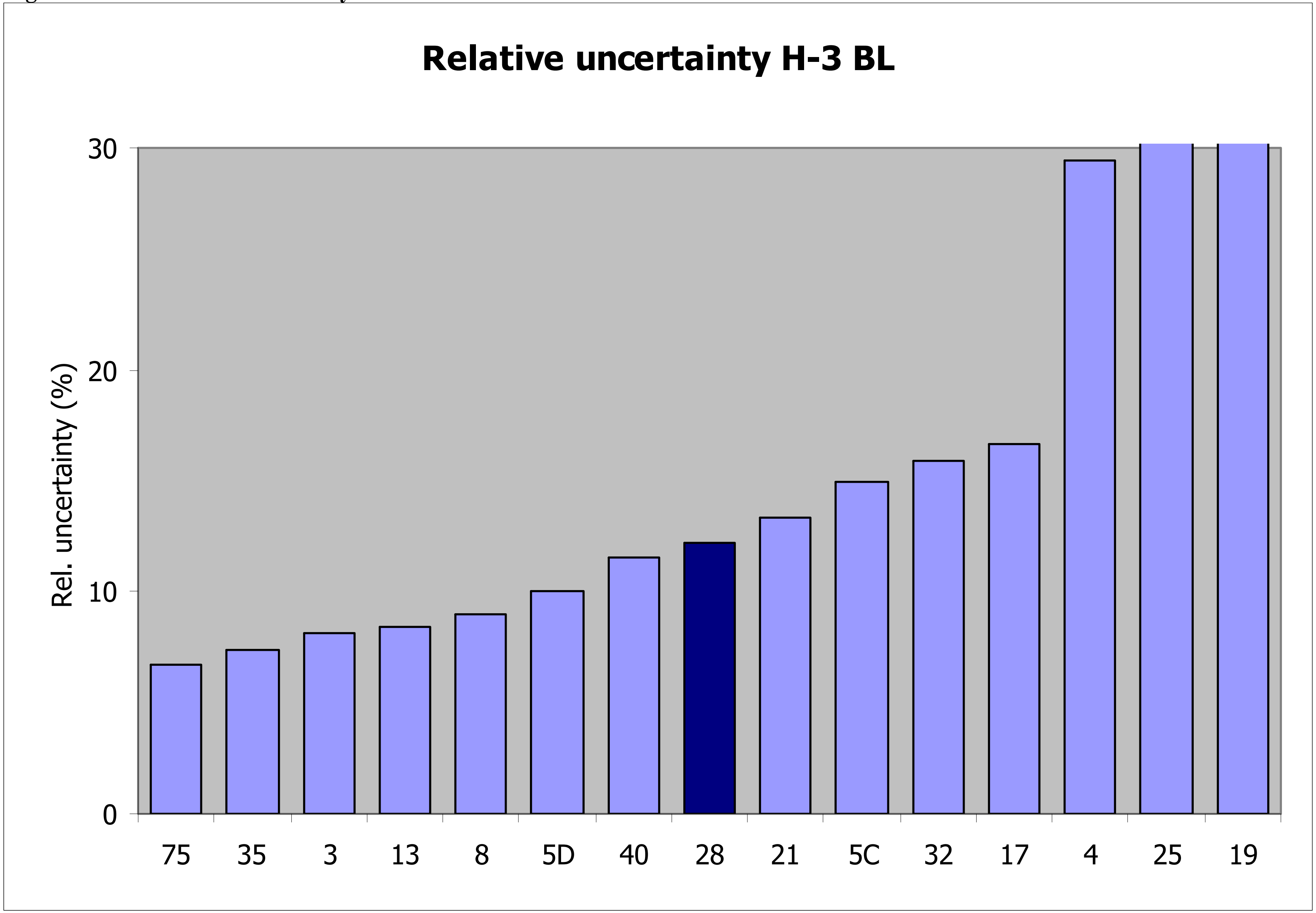


Figure 17D – Kiri plot H-3 BL

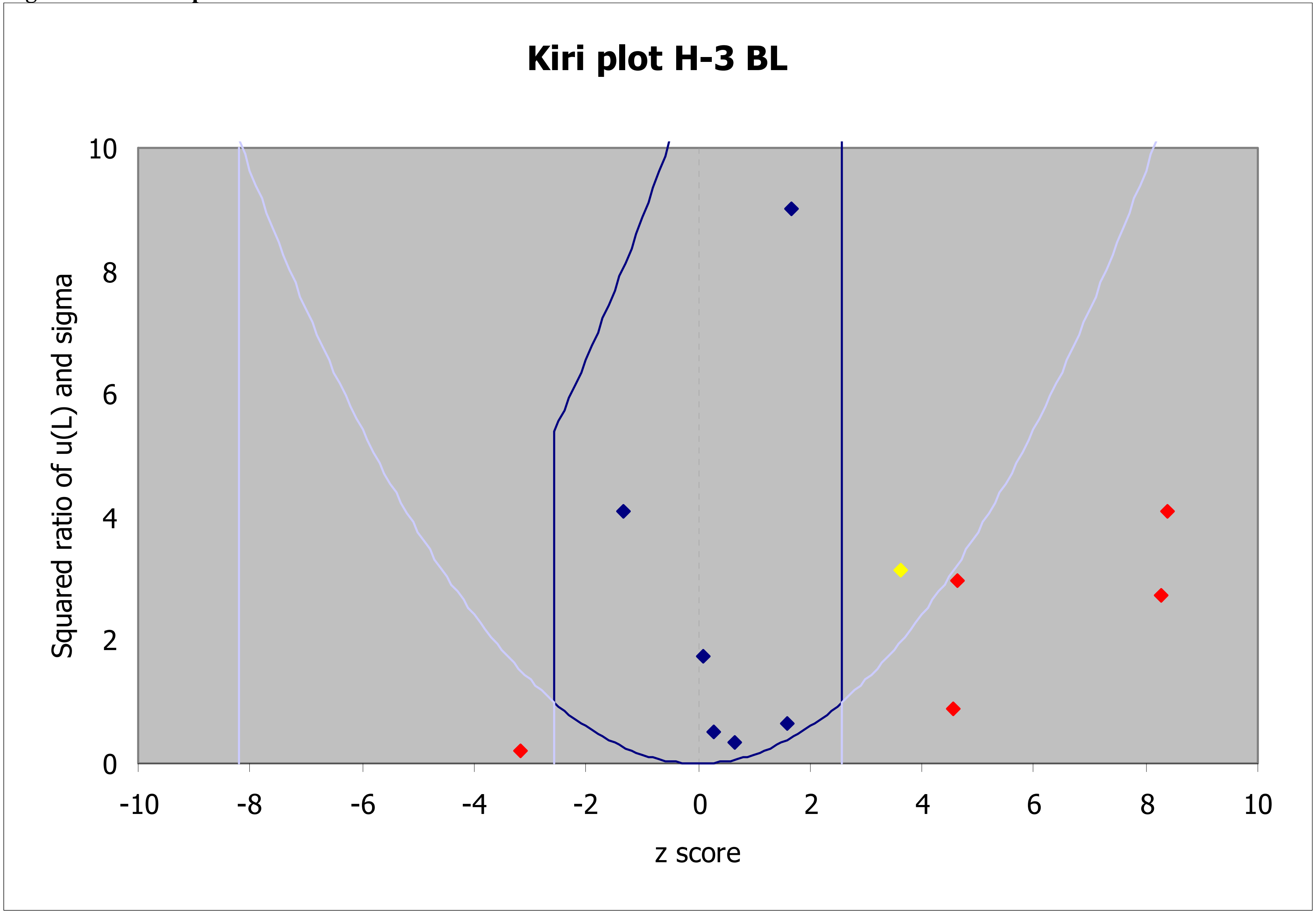


Figure 18A – Deviation Fe-55 BL

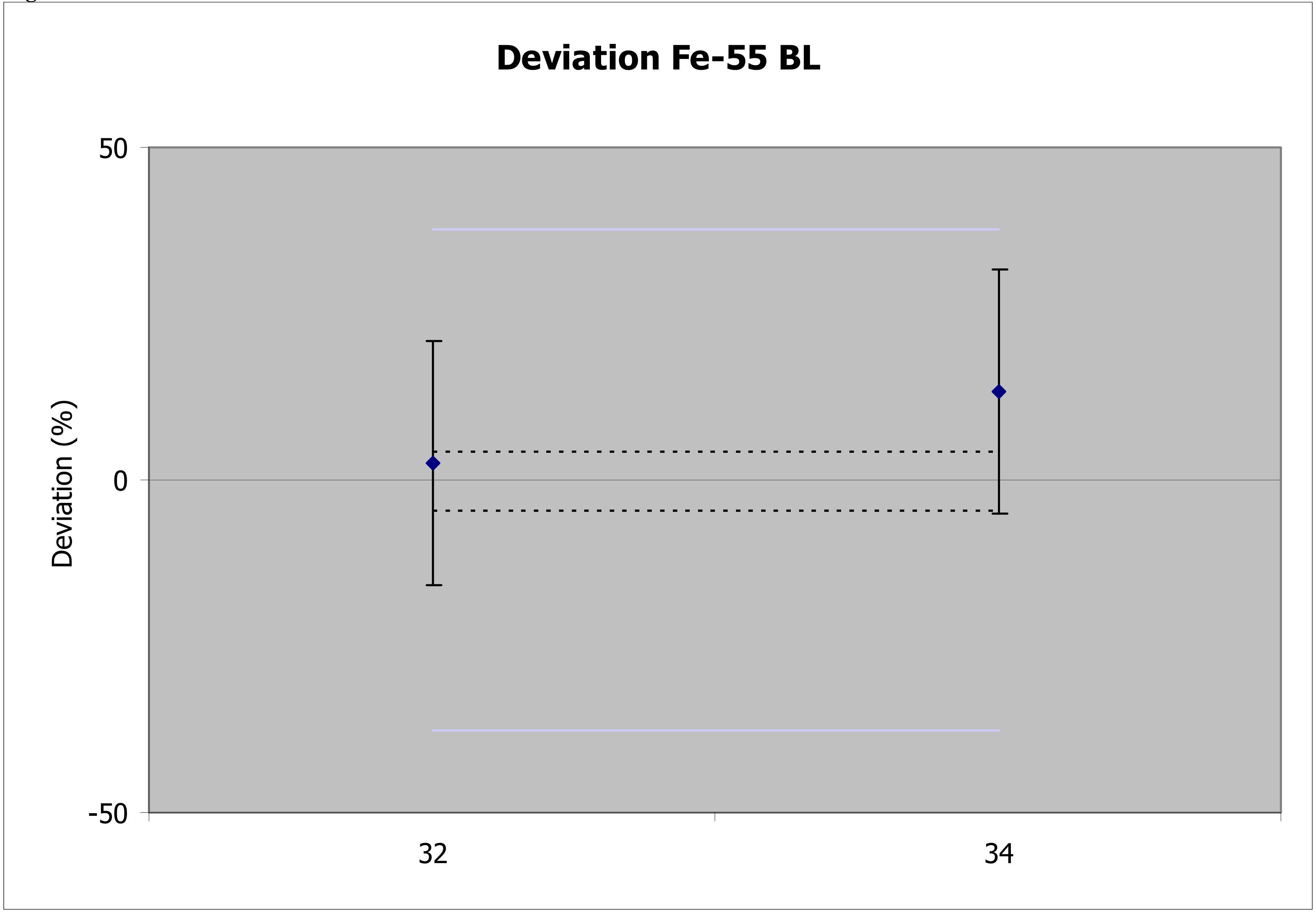


Figure 18B – Zeta score Fe-55 BL

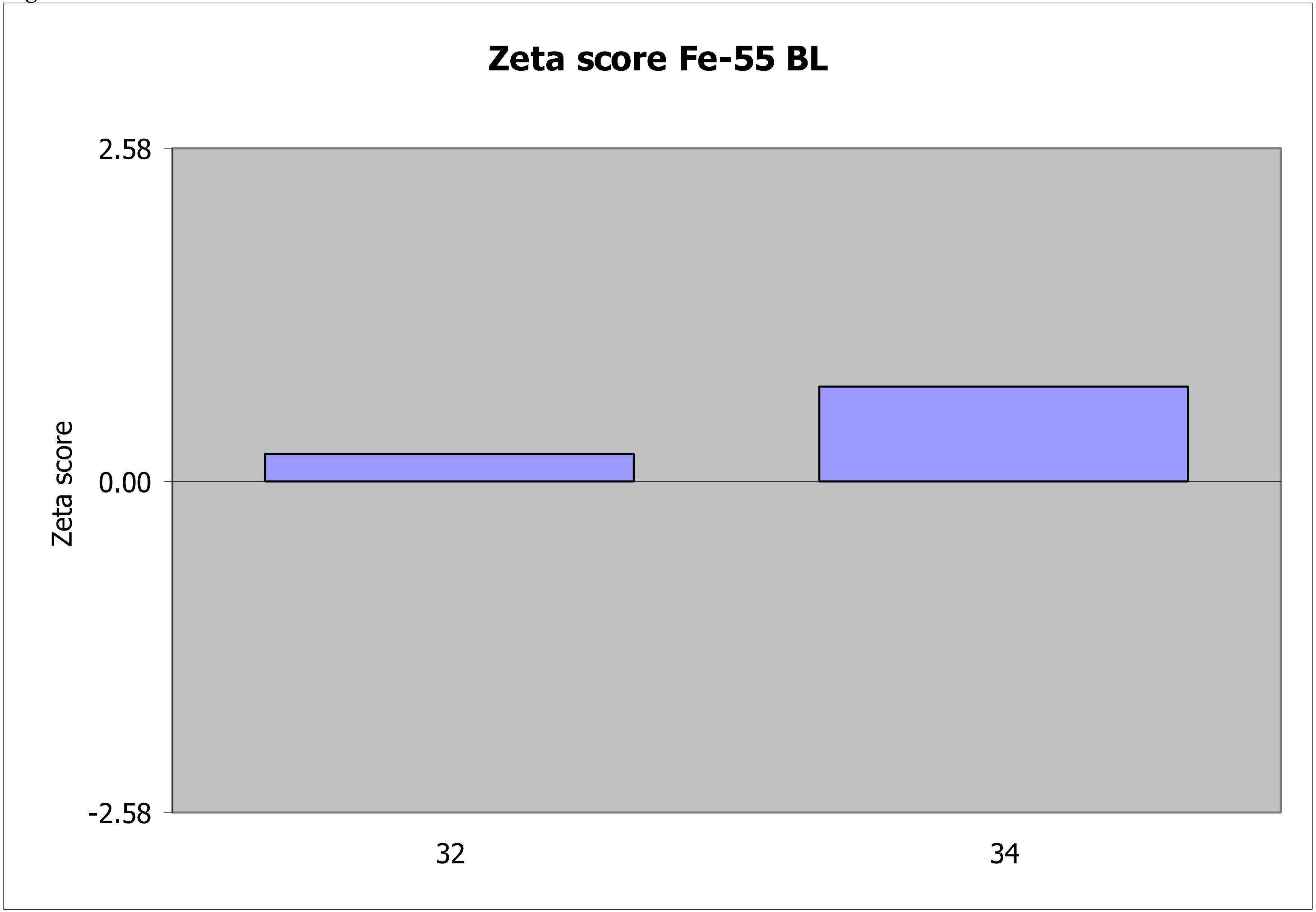


Figure 18C – Relative uncertainty Fe-55 BL

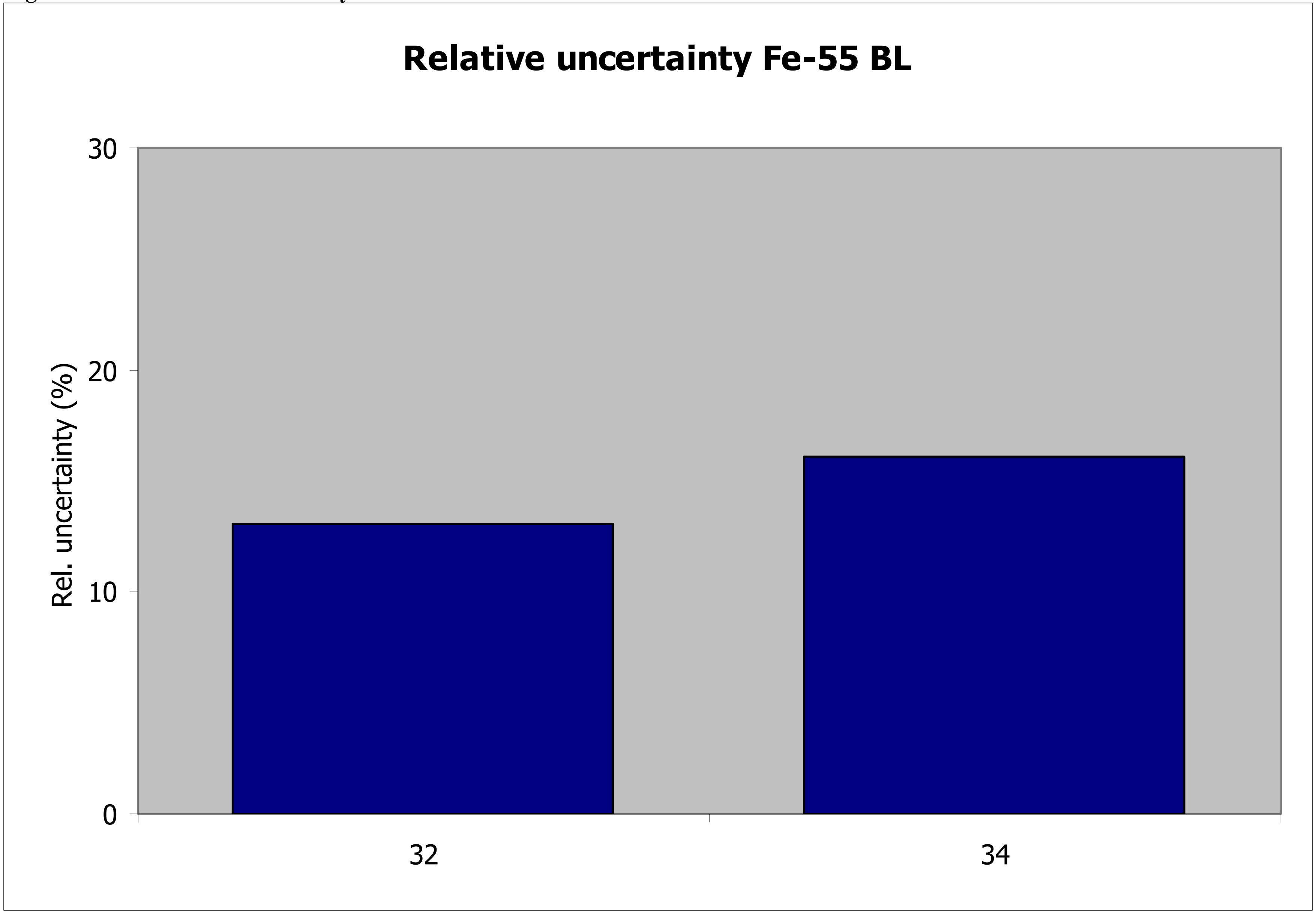


Figure 18D – Kiri plot Fe-55 BL

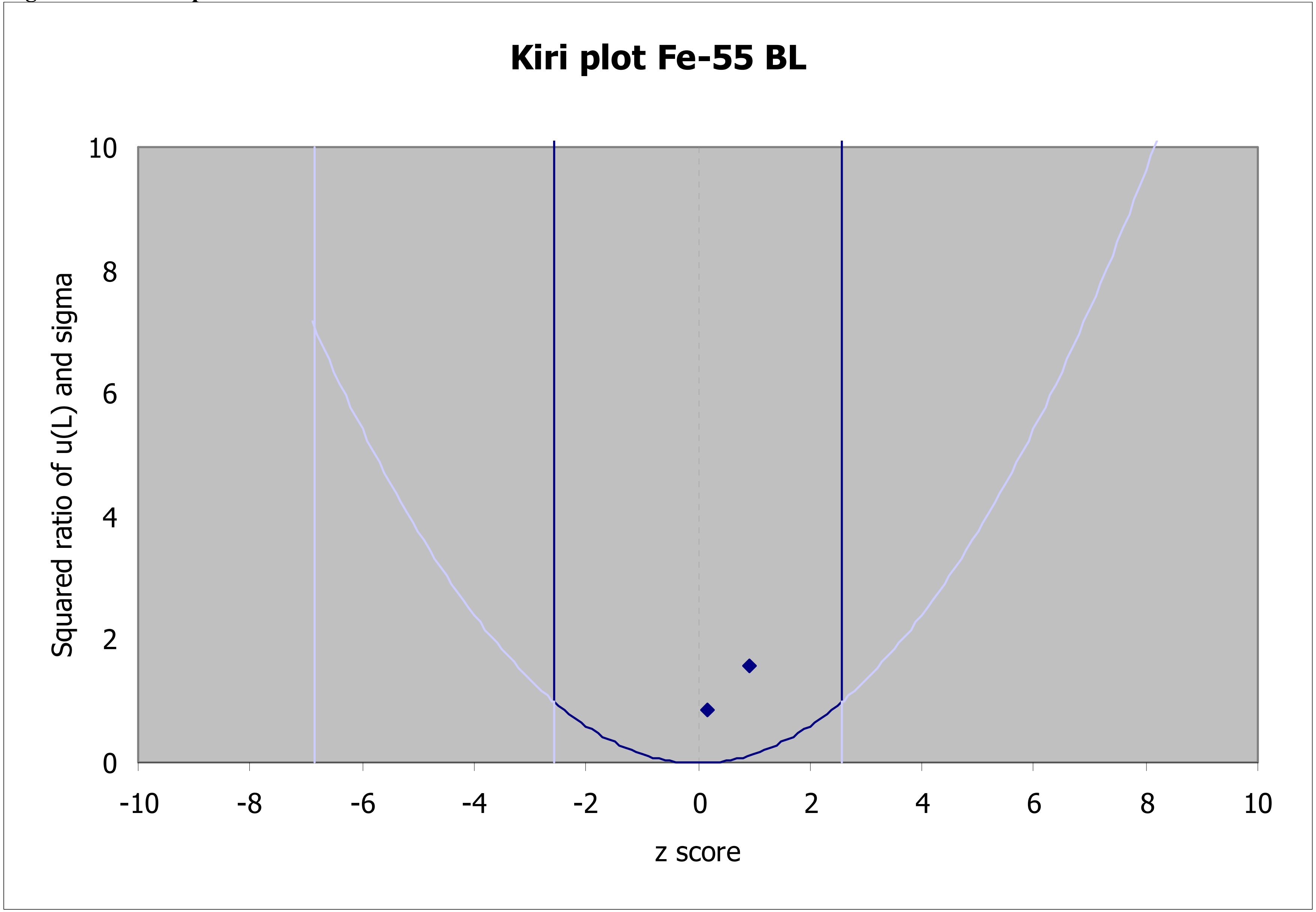


Figure 19A – Deviation Ni-63 BL

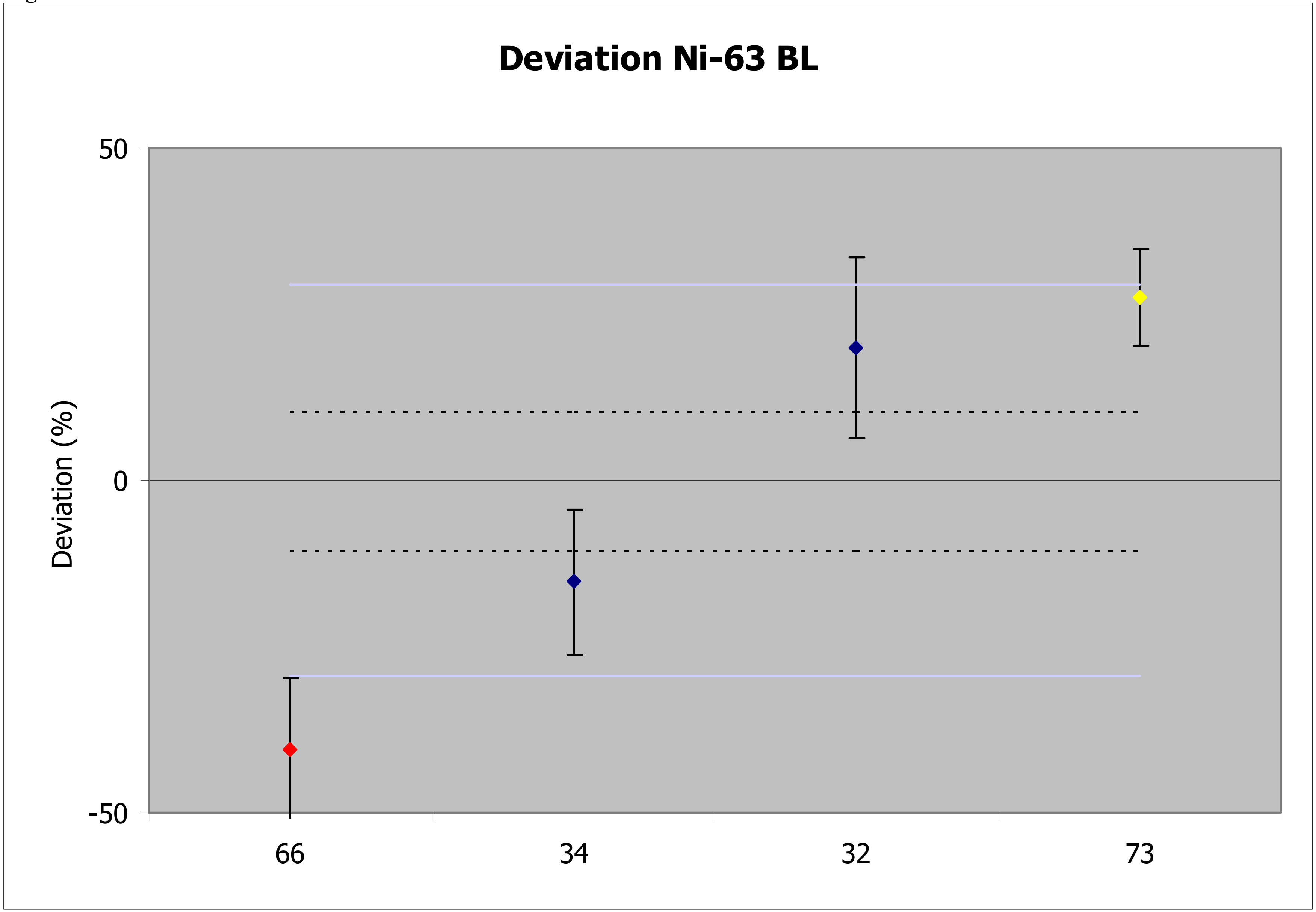


Figure 19B – Zeta score Ni-63 BL

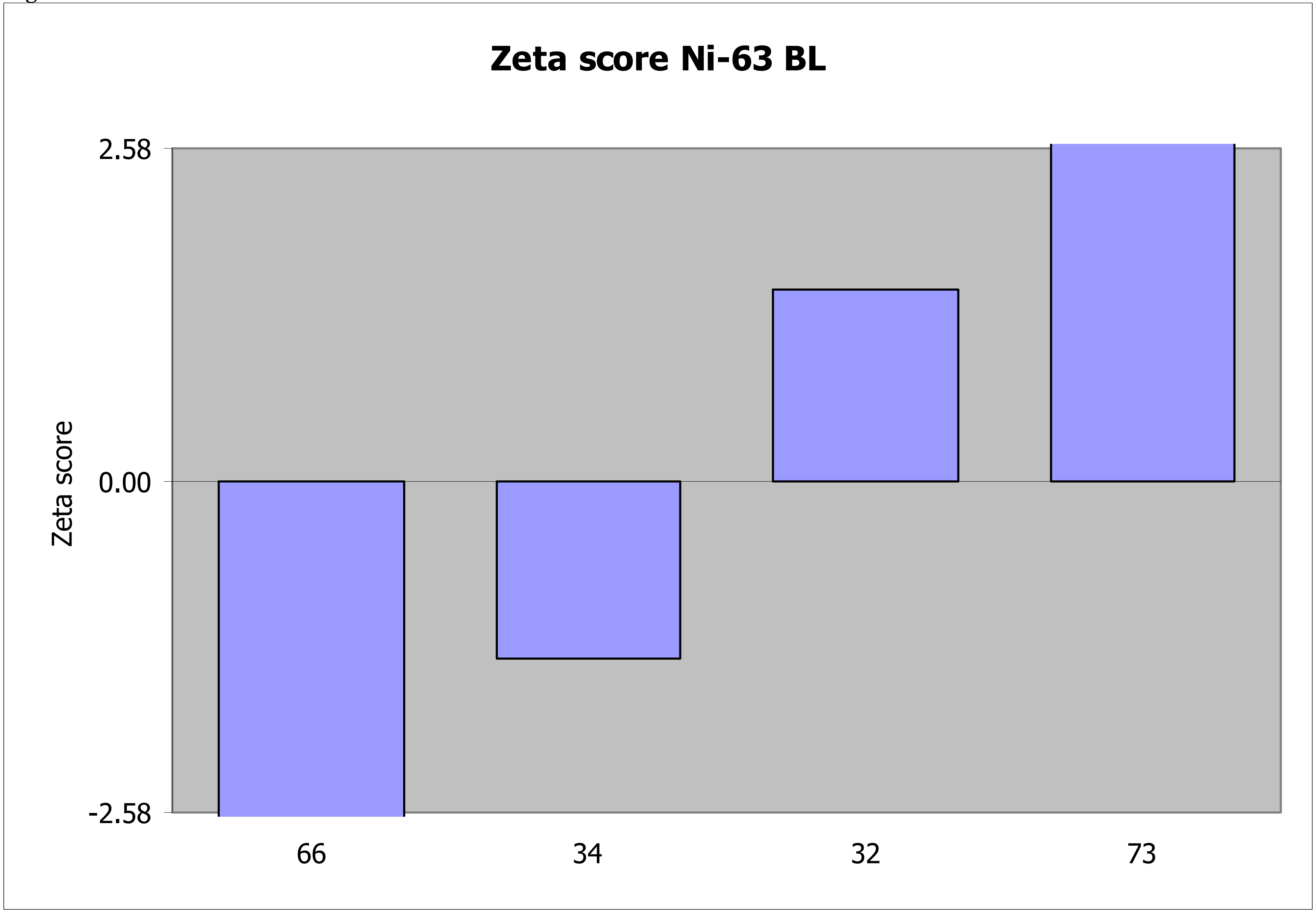


Figure 19C – Relative uncertainty Ni-63 BL

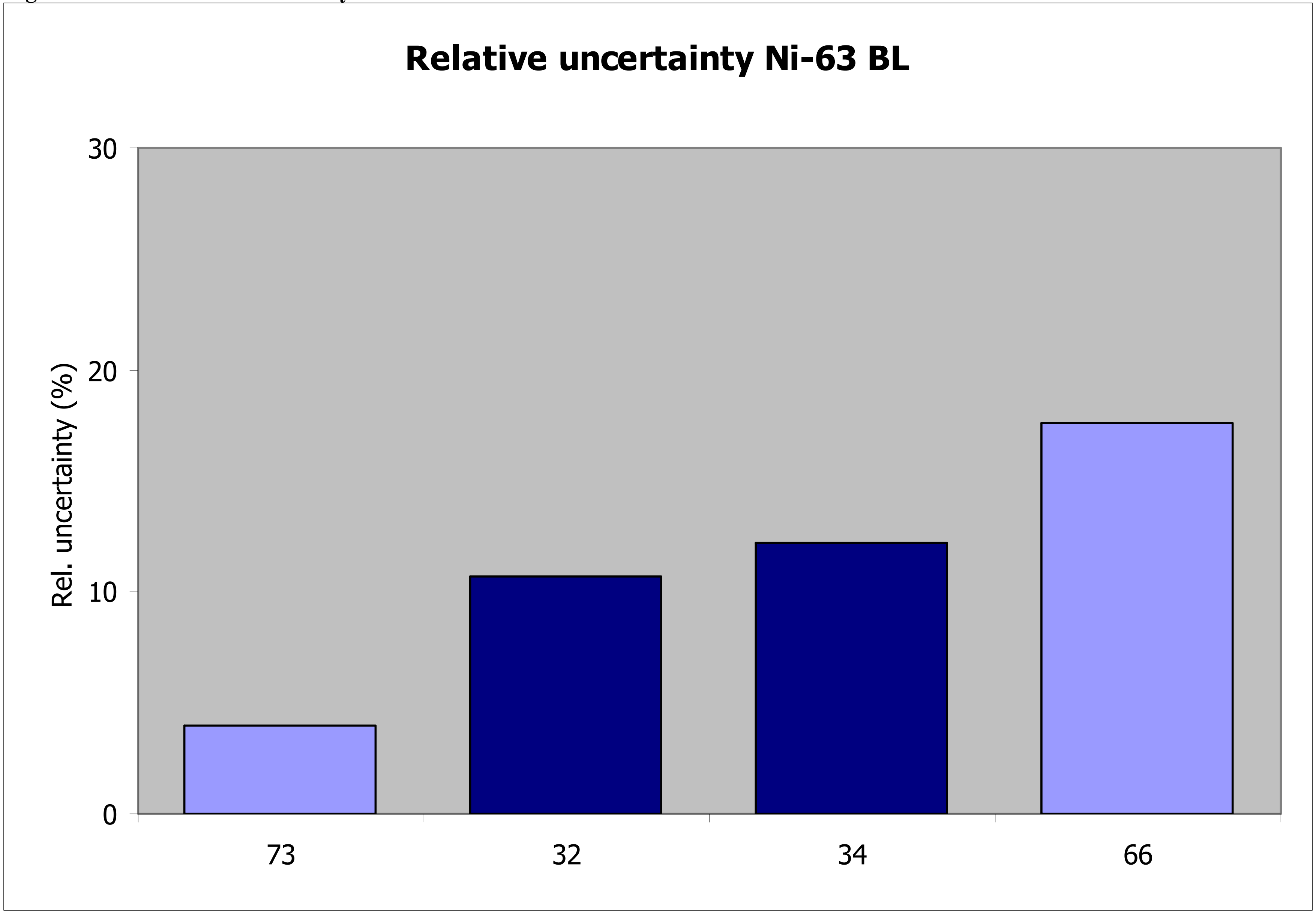


Figure 19D – Kiri plot Ni-63 BL

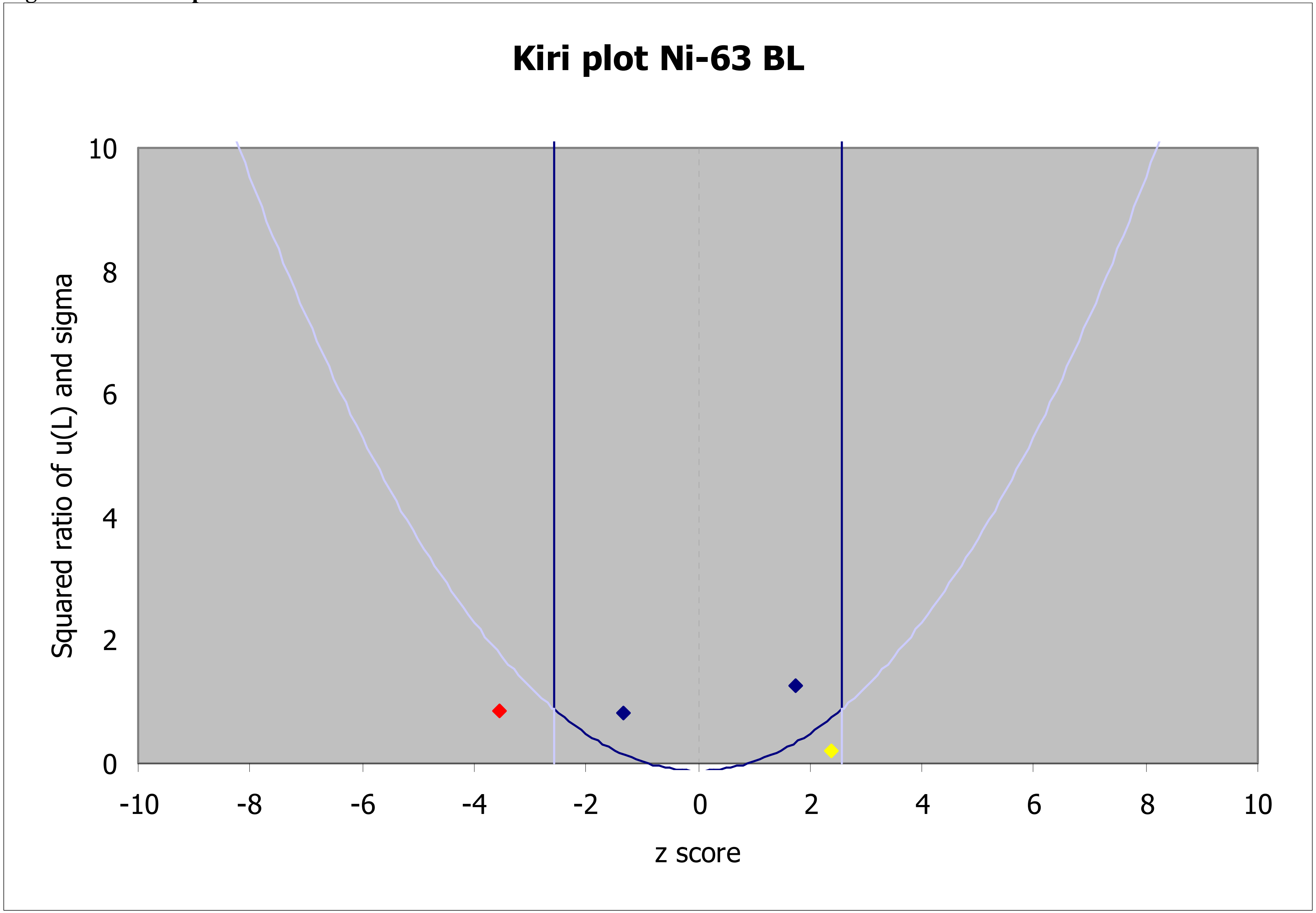


Figure 20A – Deviation Sr-89 BL

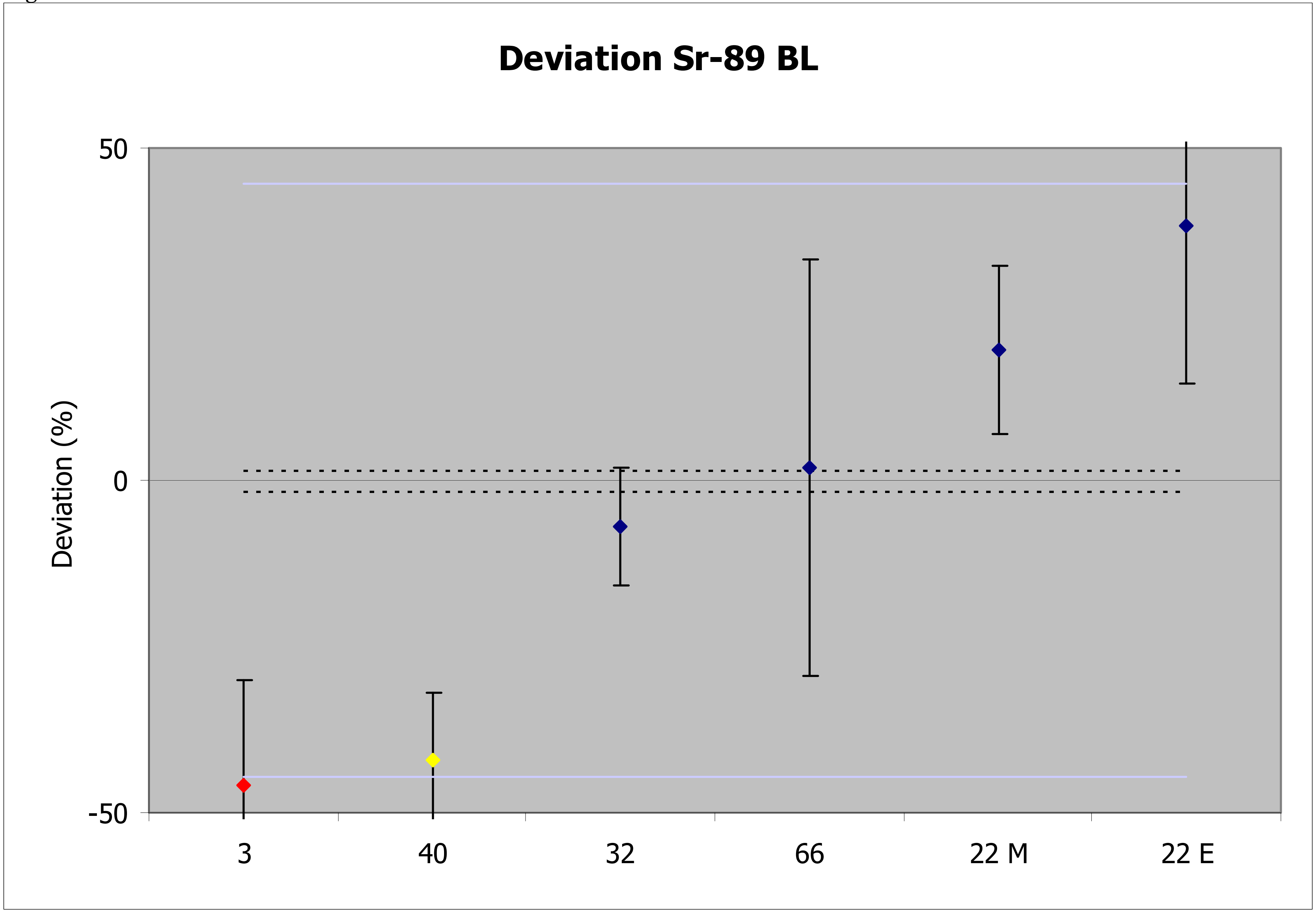


Figure 20B – Zeta score Sr-89 BL

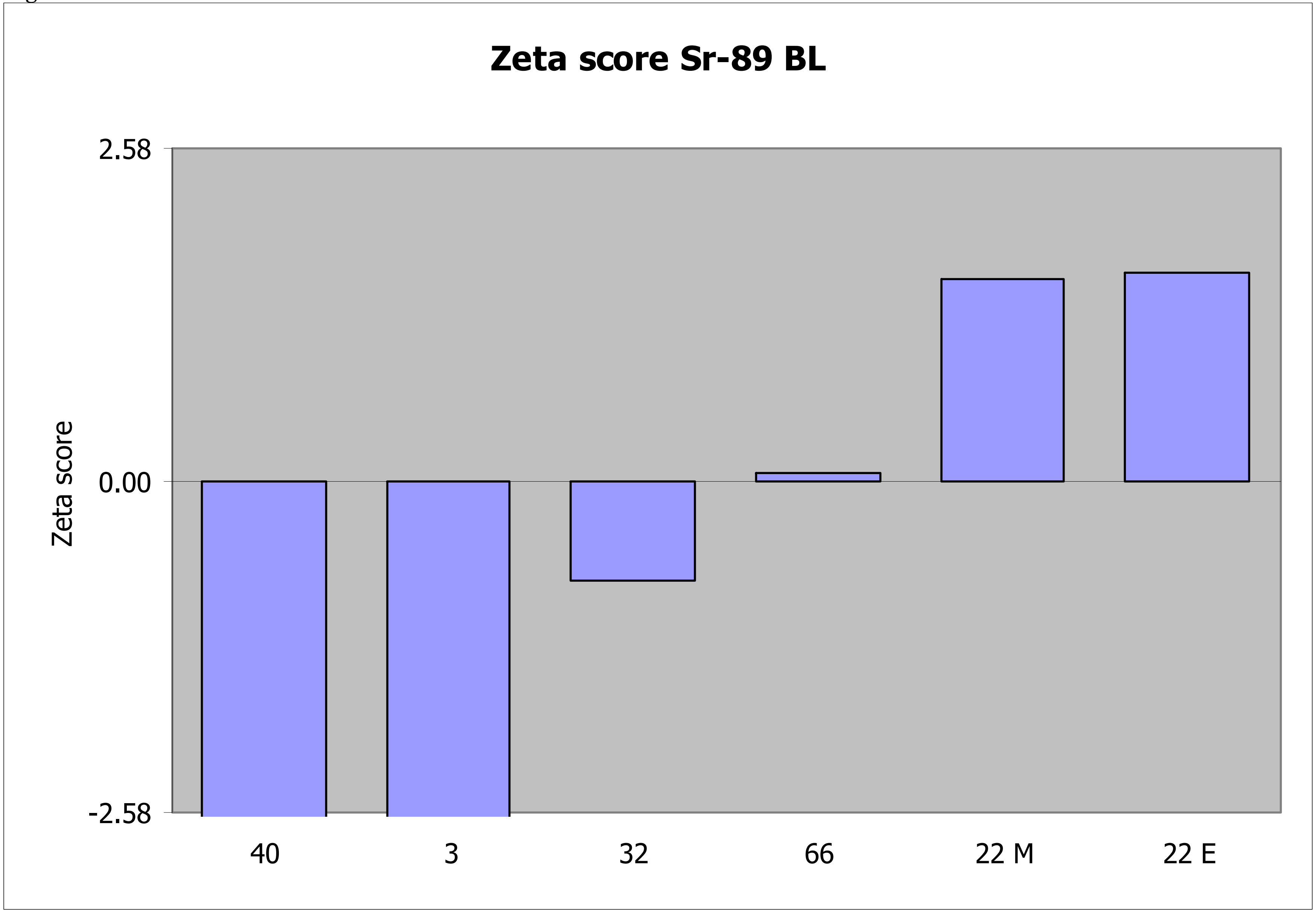


Figure 20C – Relative uncertainty Sr-89 BL

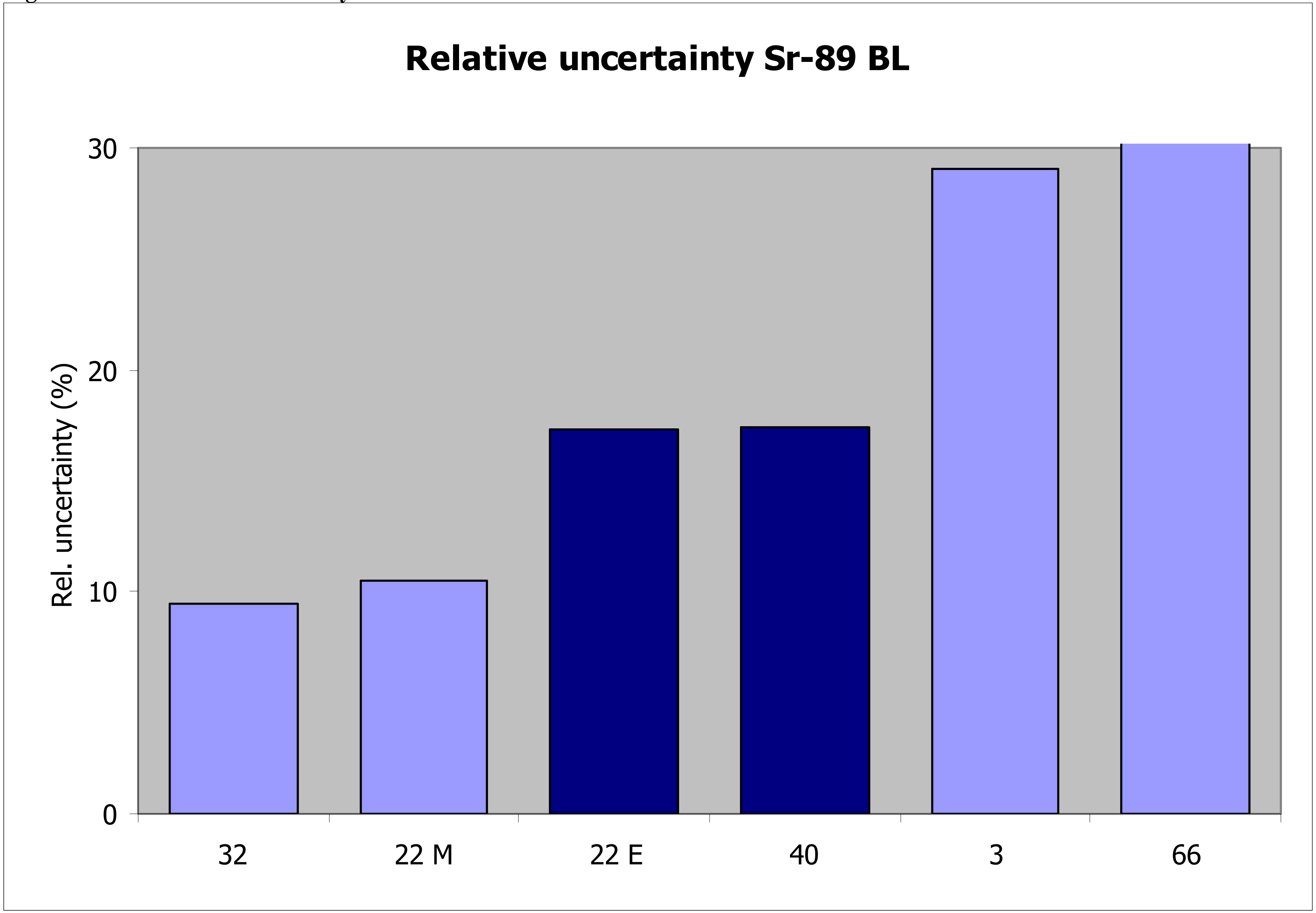


Figure 20D – Kiri plot Sr-89 BL

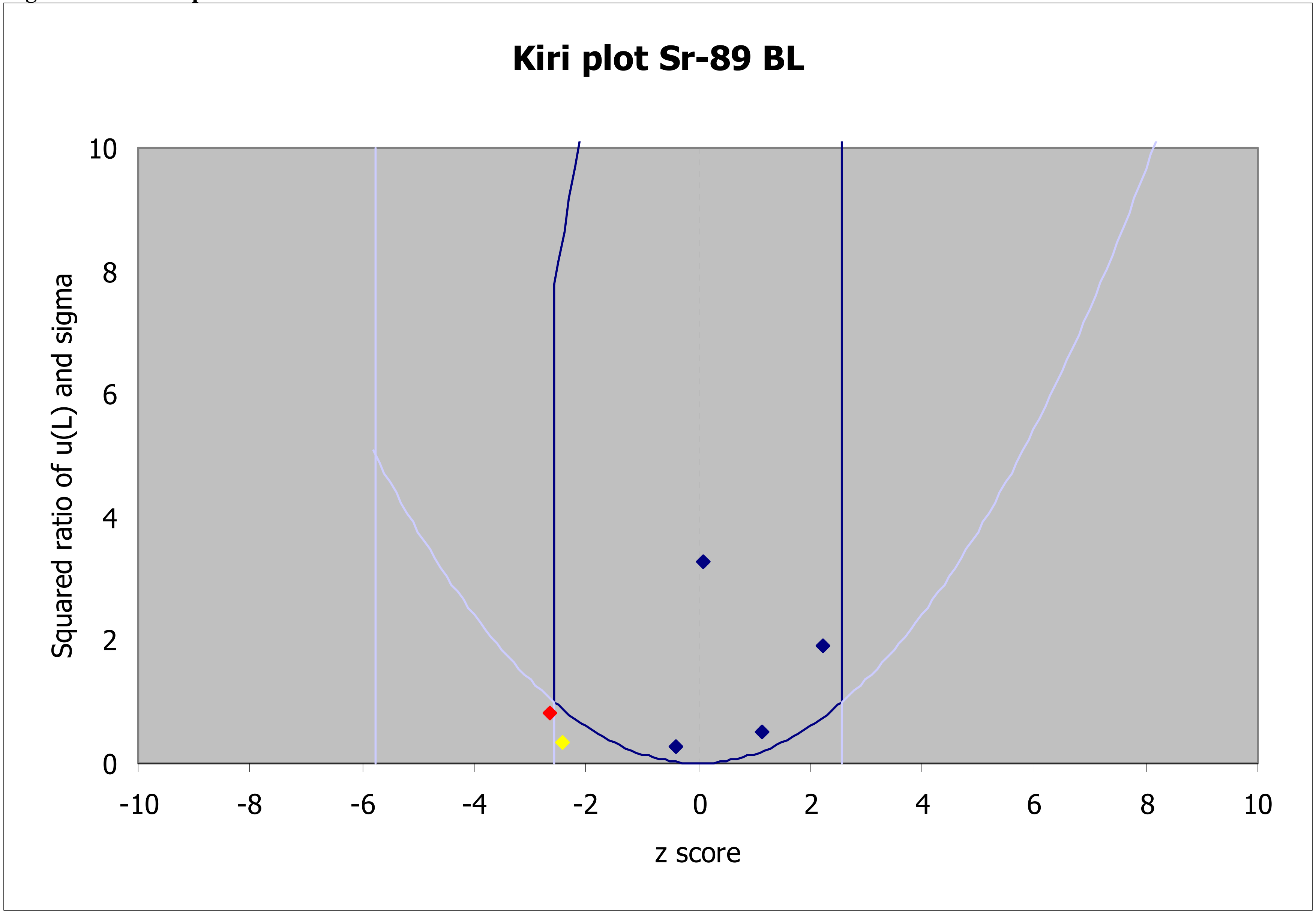


Figure 21A – Deviation Sr-90 BL

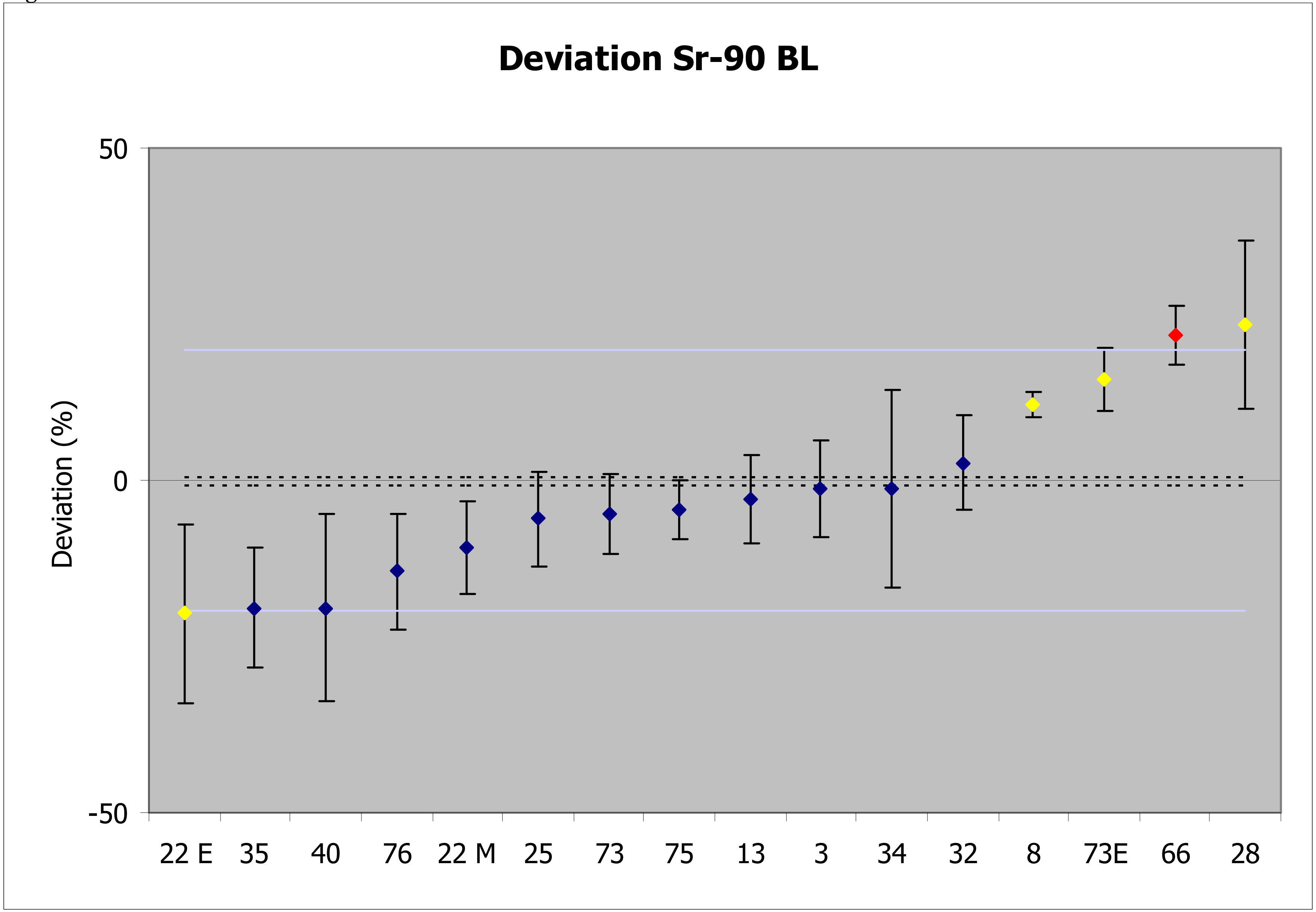


Figure 21B – Zeta score Sr-90 BL

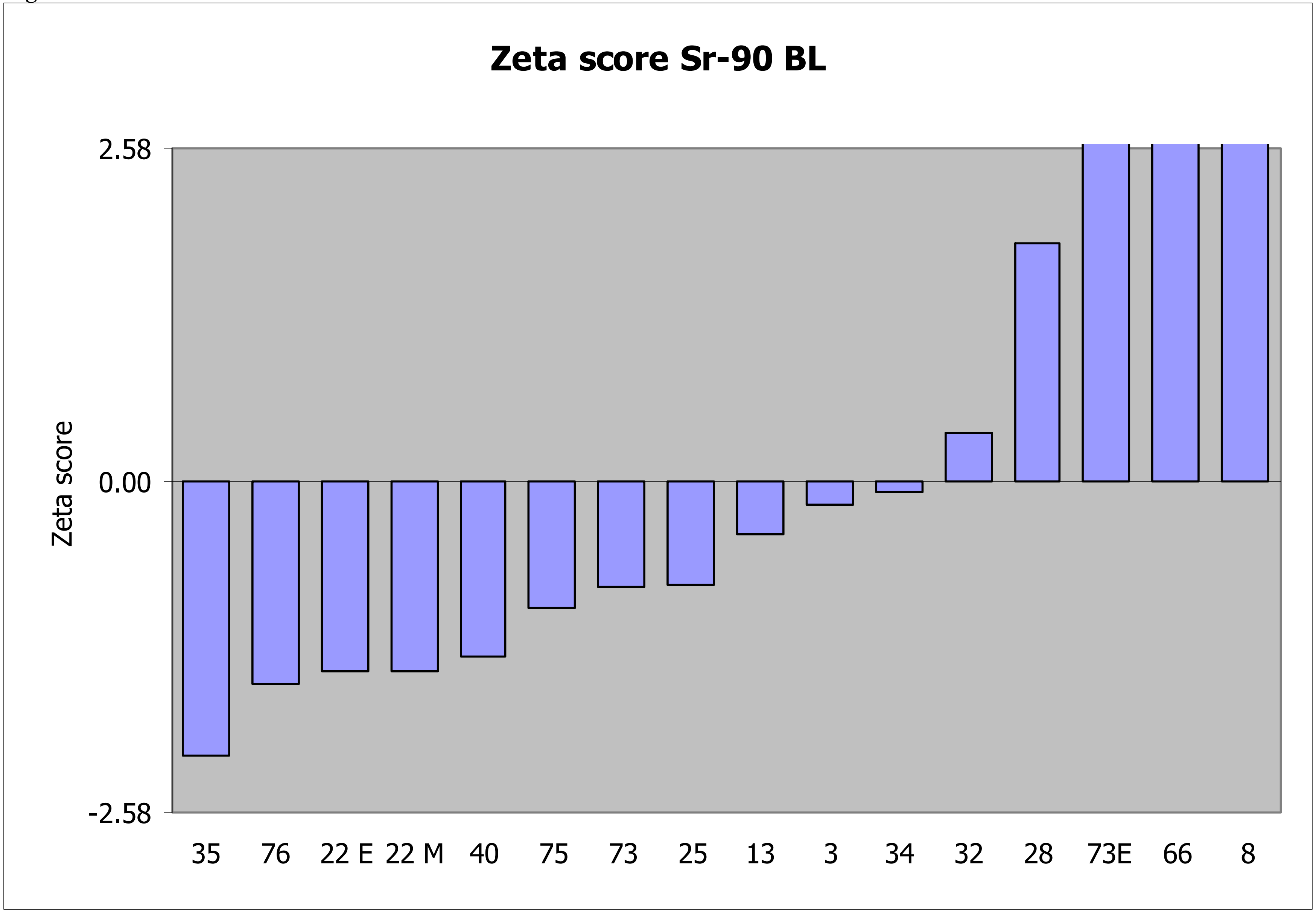


Figure 21C – Relative uncertainty Sr-90 BL

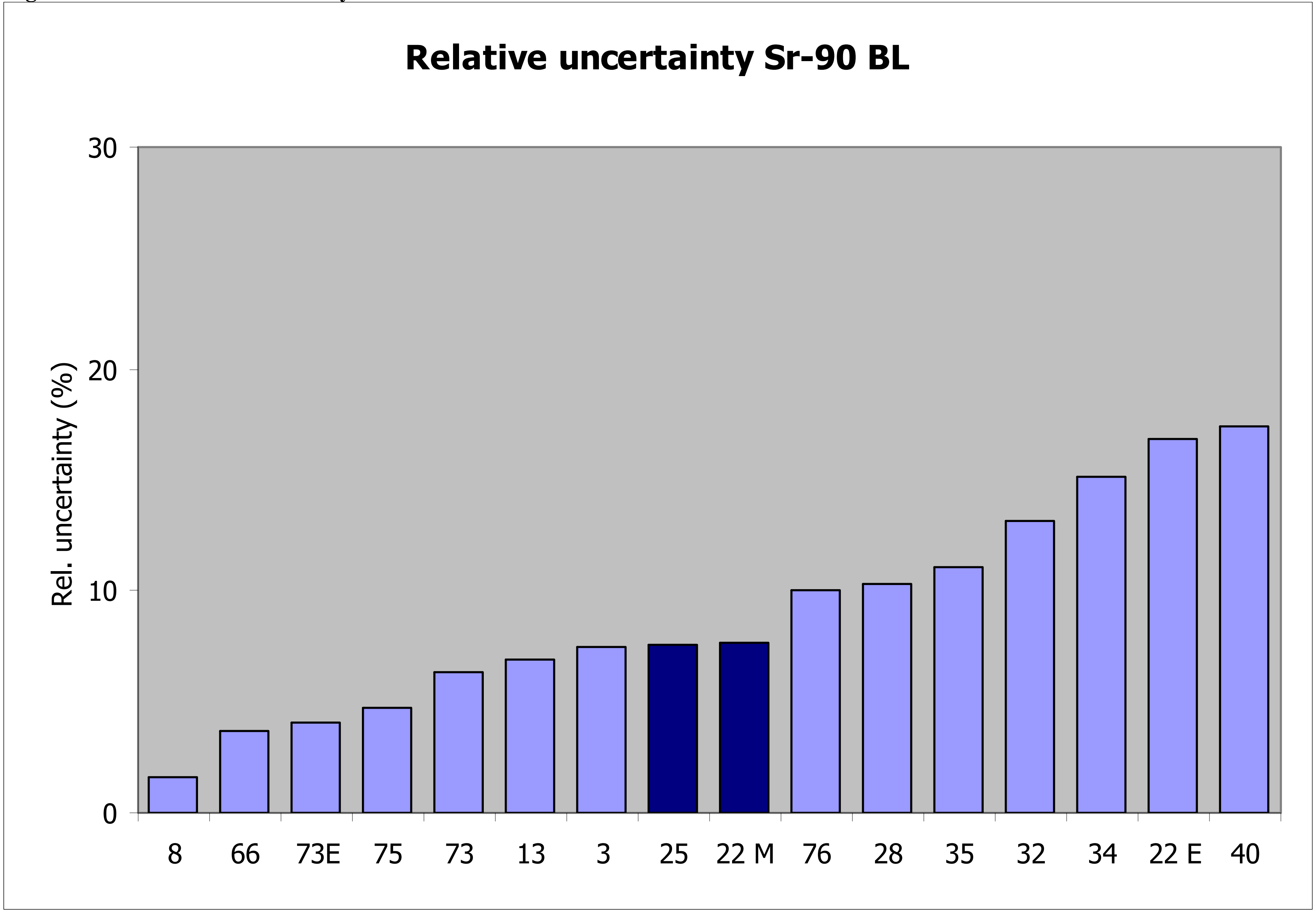


Figure 21D – Kiri plot Sr-90 BL

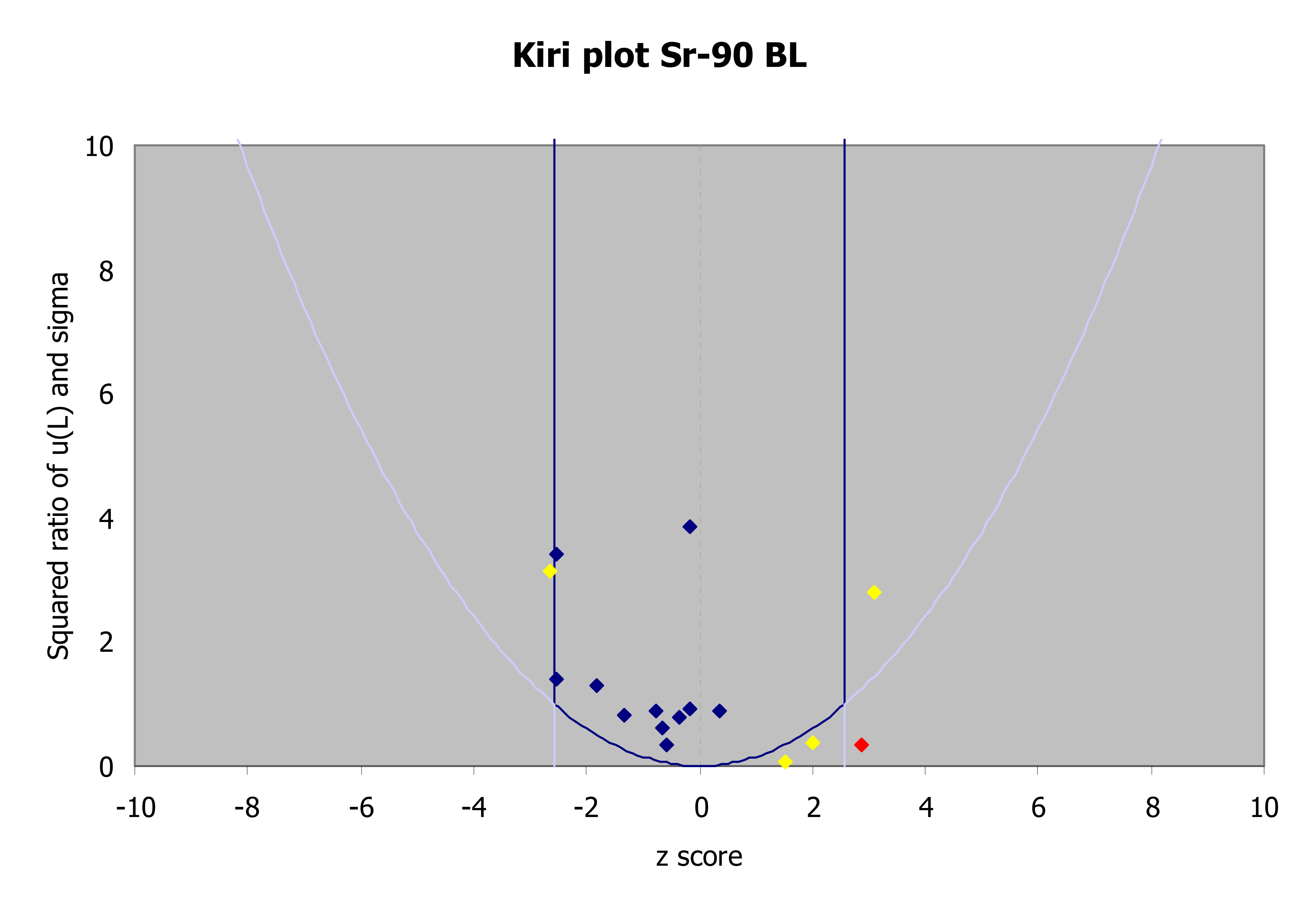


Figure 22A – Deviation Tc-99 BL

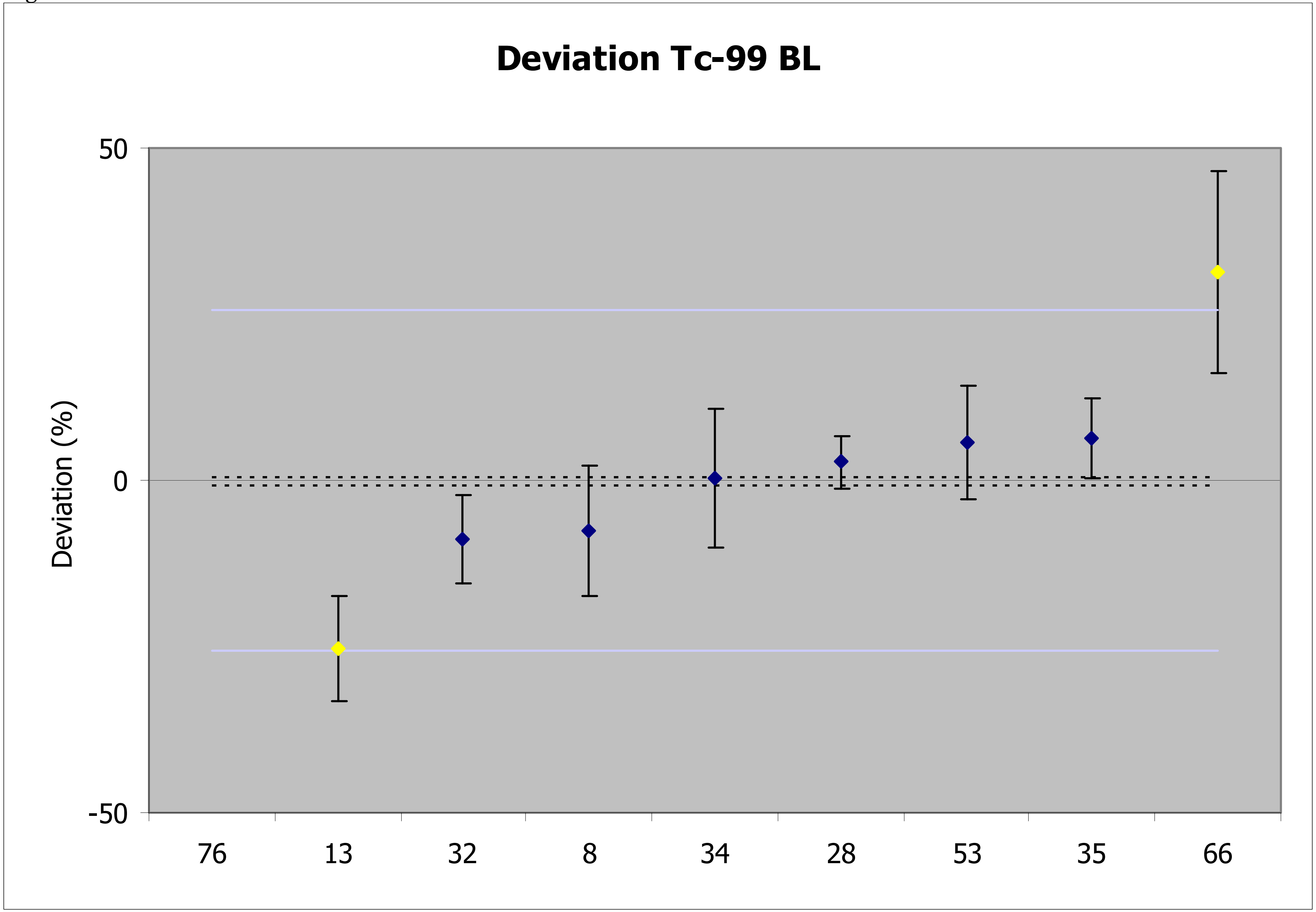


Figure 22B – Zeta score Tc-99 BL

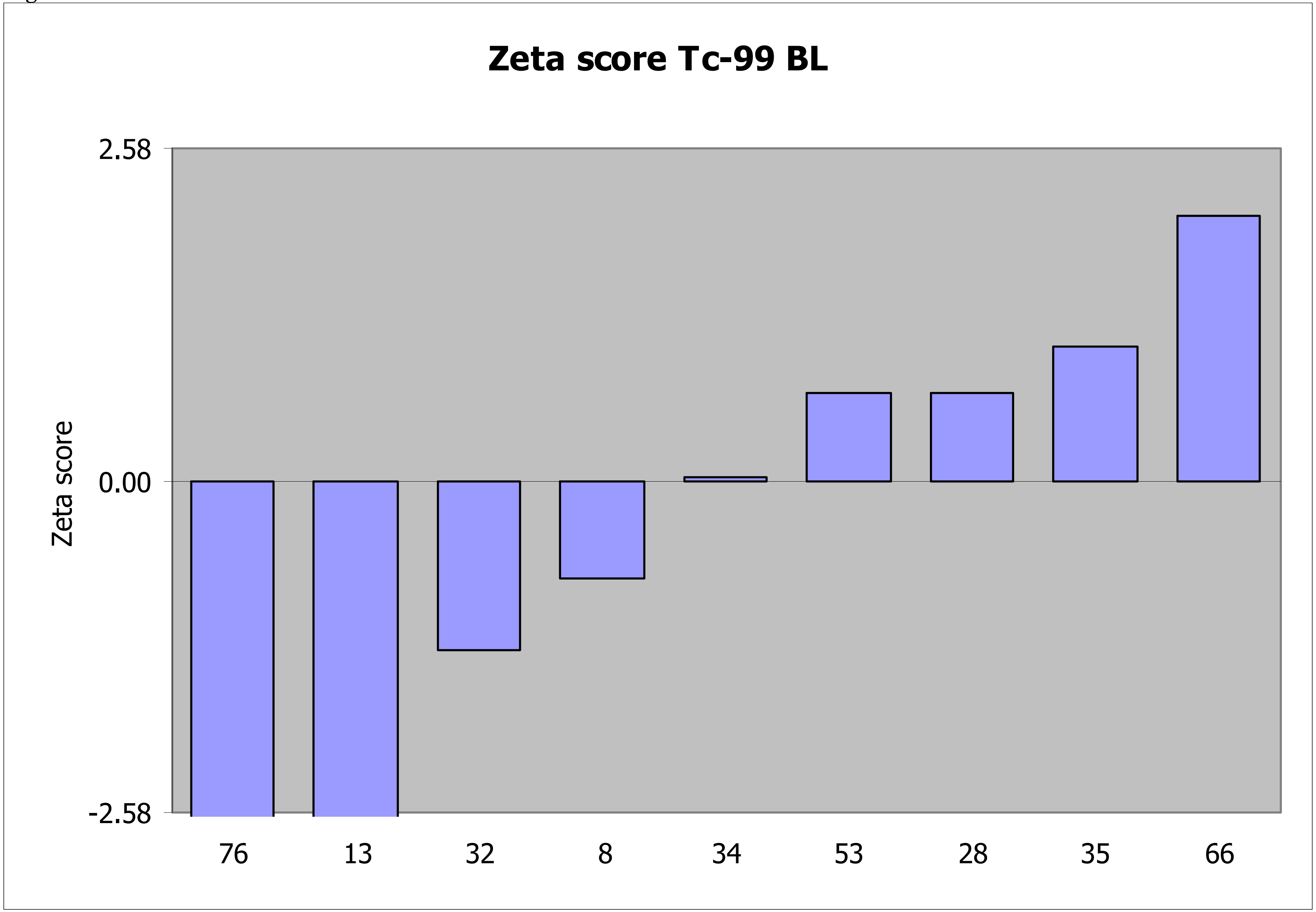


Figure 22C – Relative uncertainty Tc-99 BL

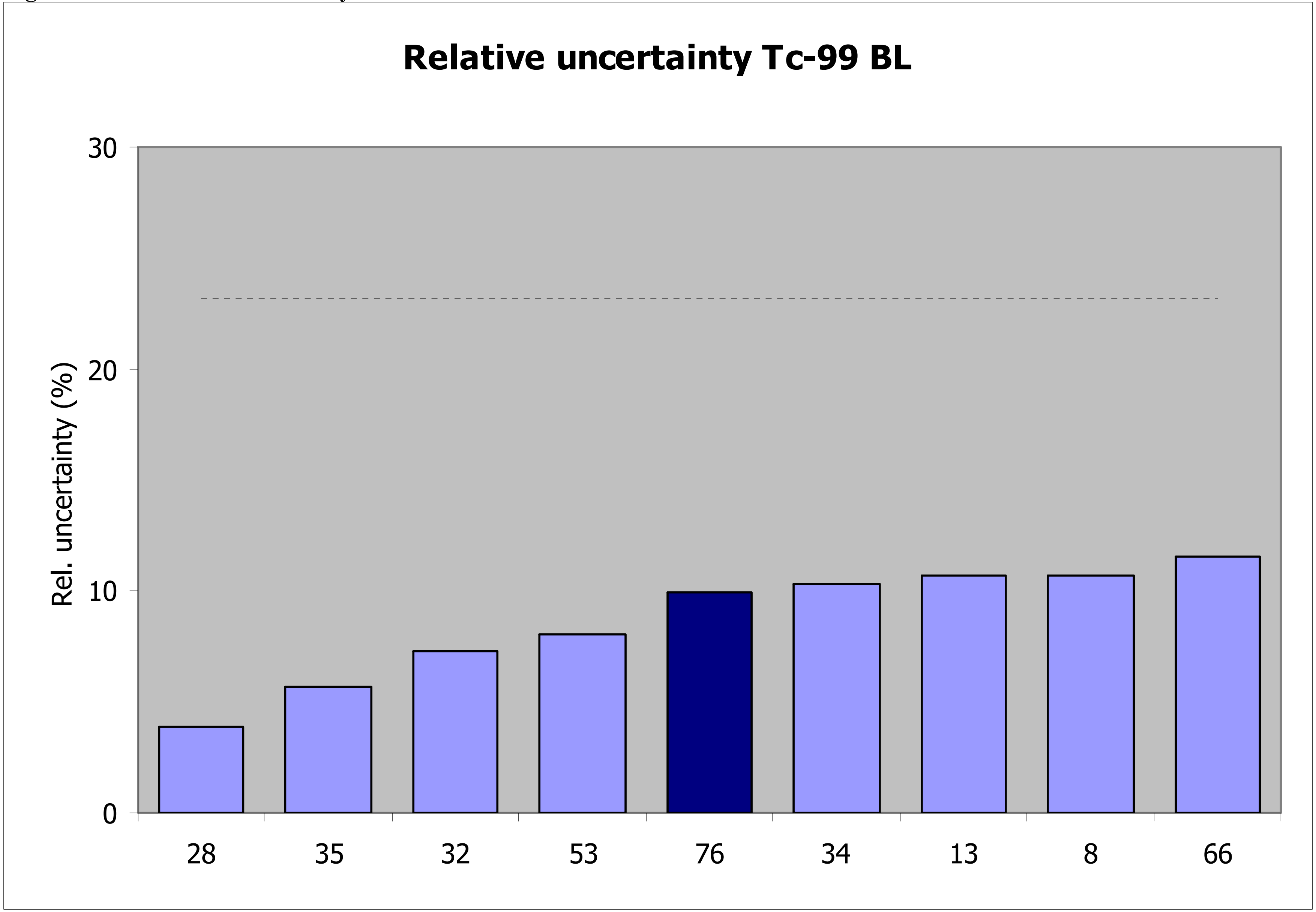


Figure 22D – Kiri plot Tc-99 BL

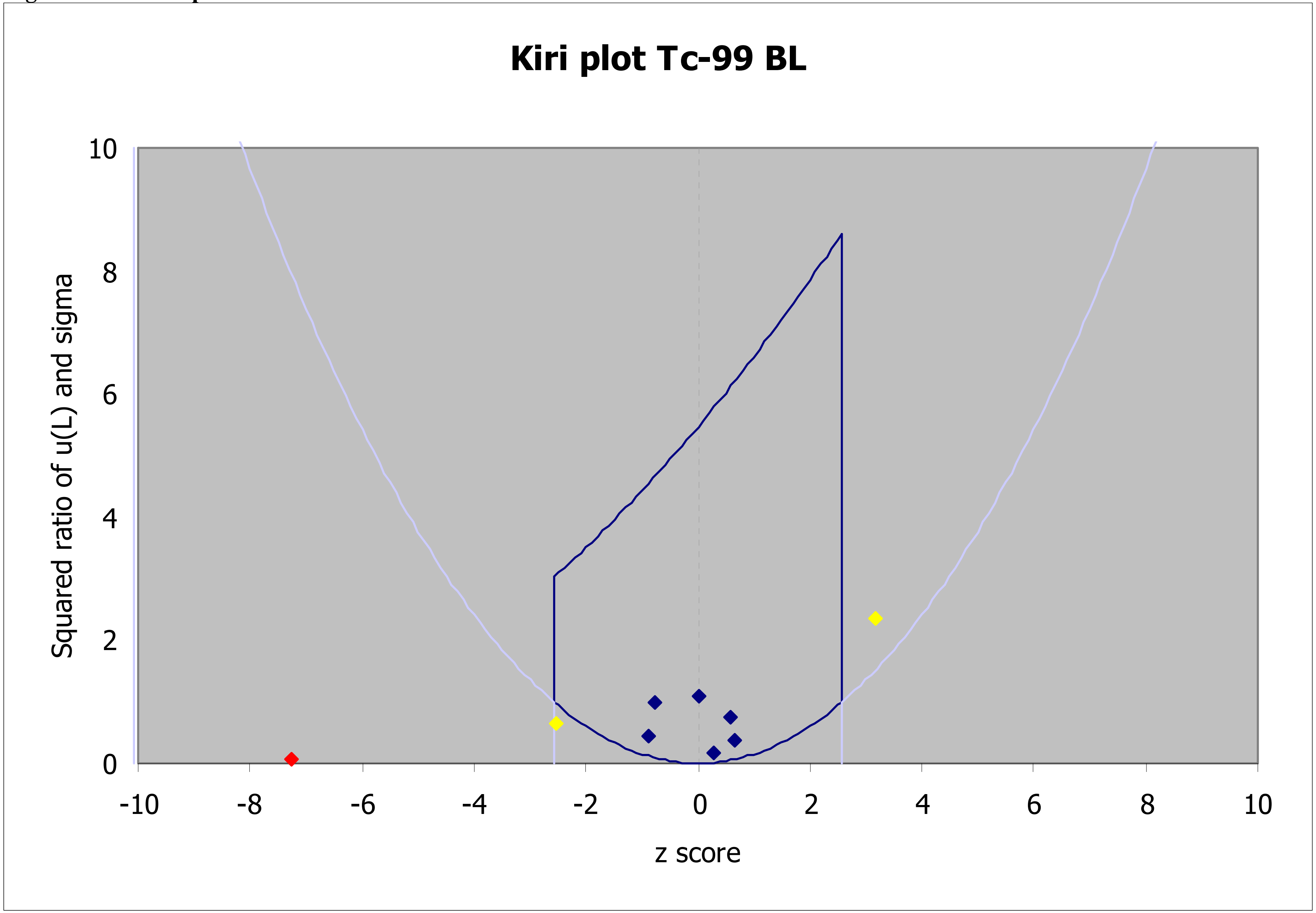


Figure 23A – Deviation gross beta BL

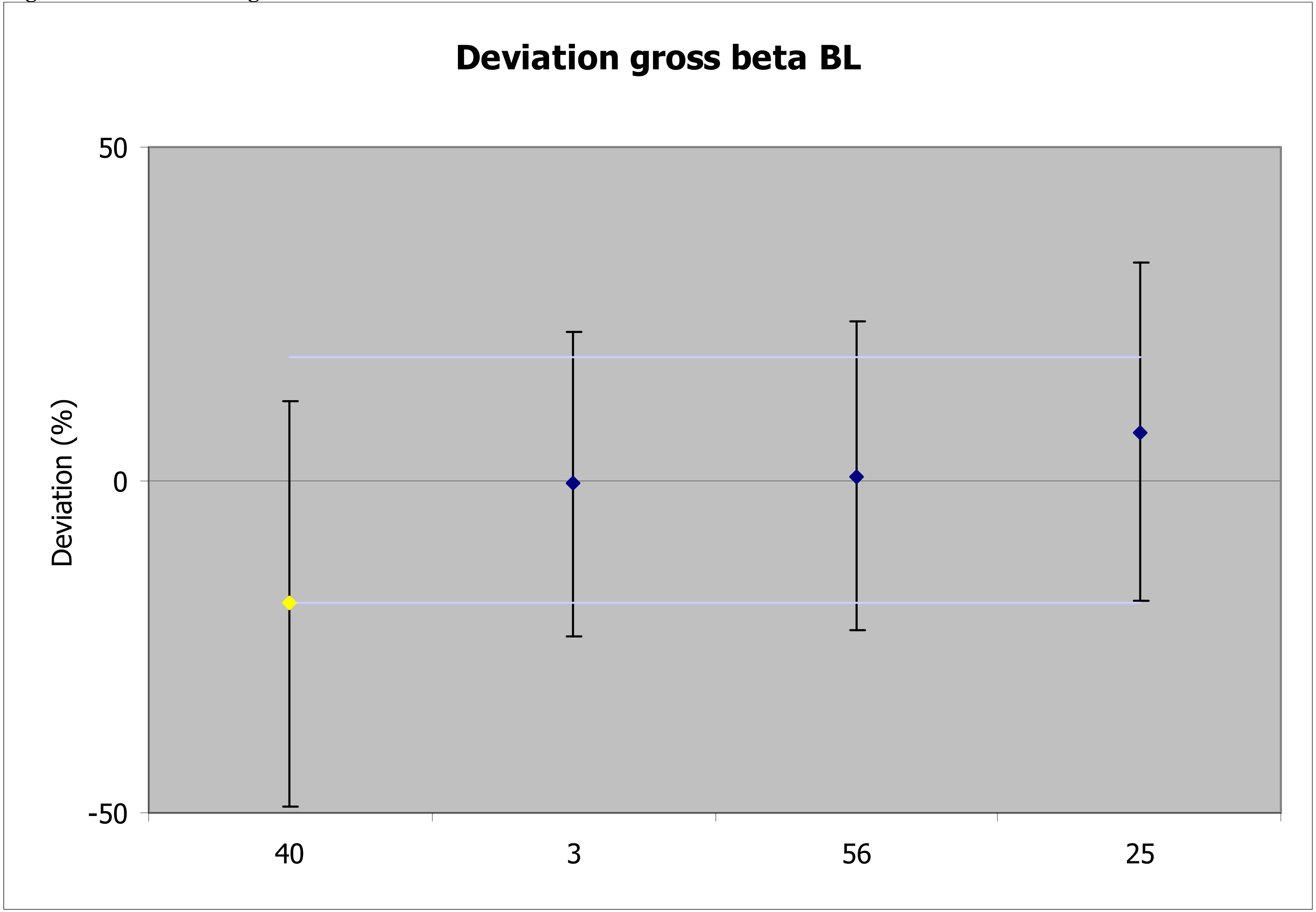


Figure 23B – Zeta score gross beta BL

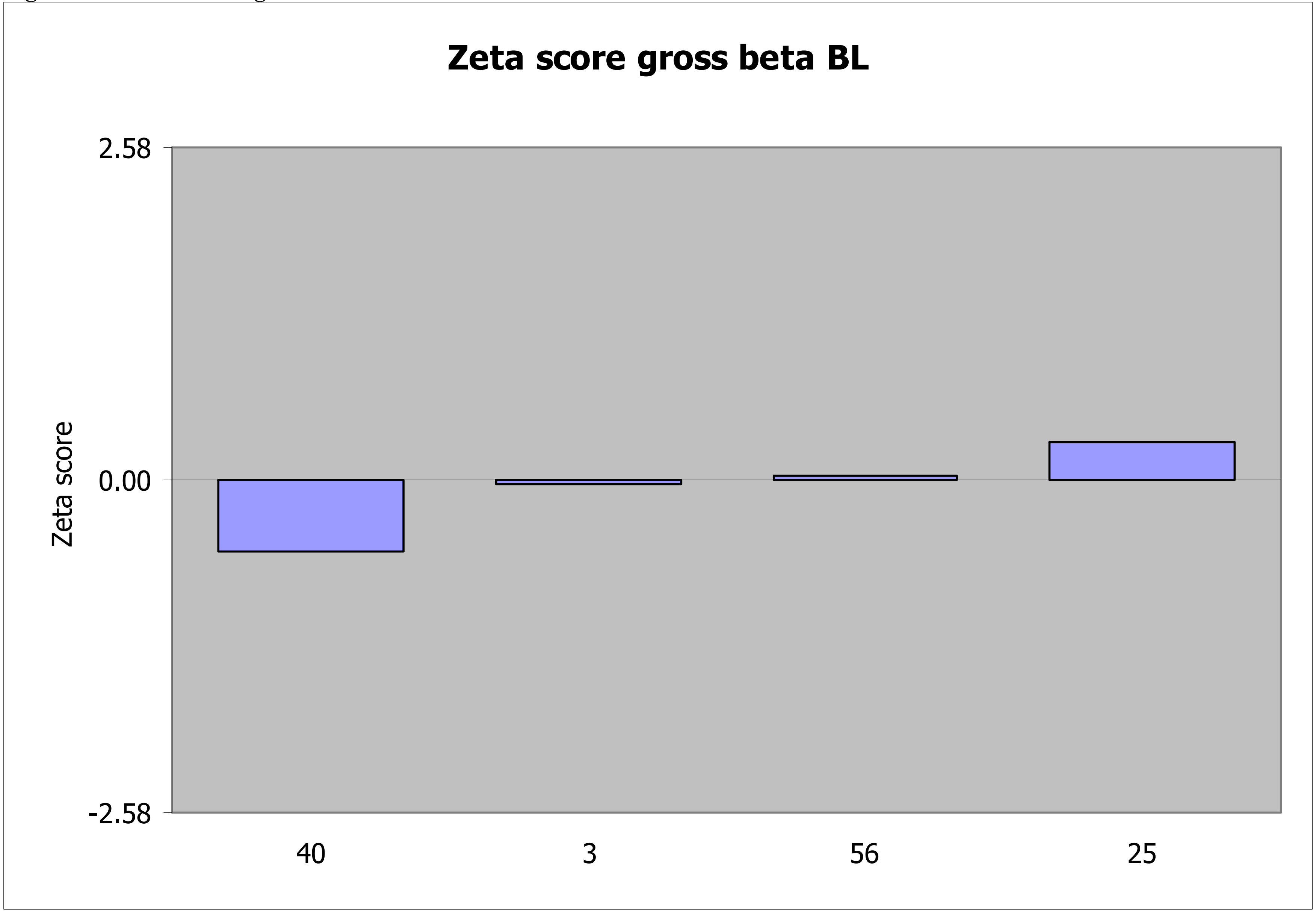


Figure 23C – Relative uncertainty gross beta BL

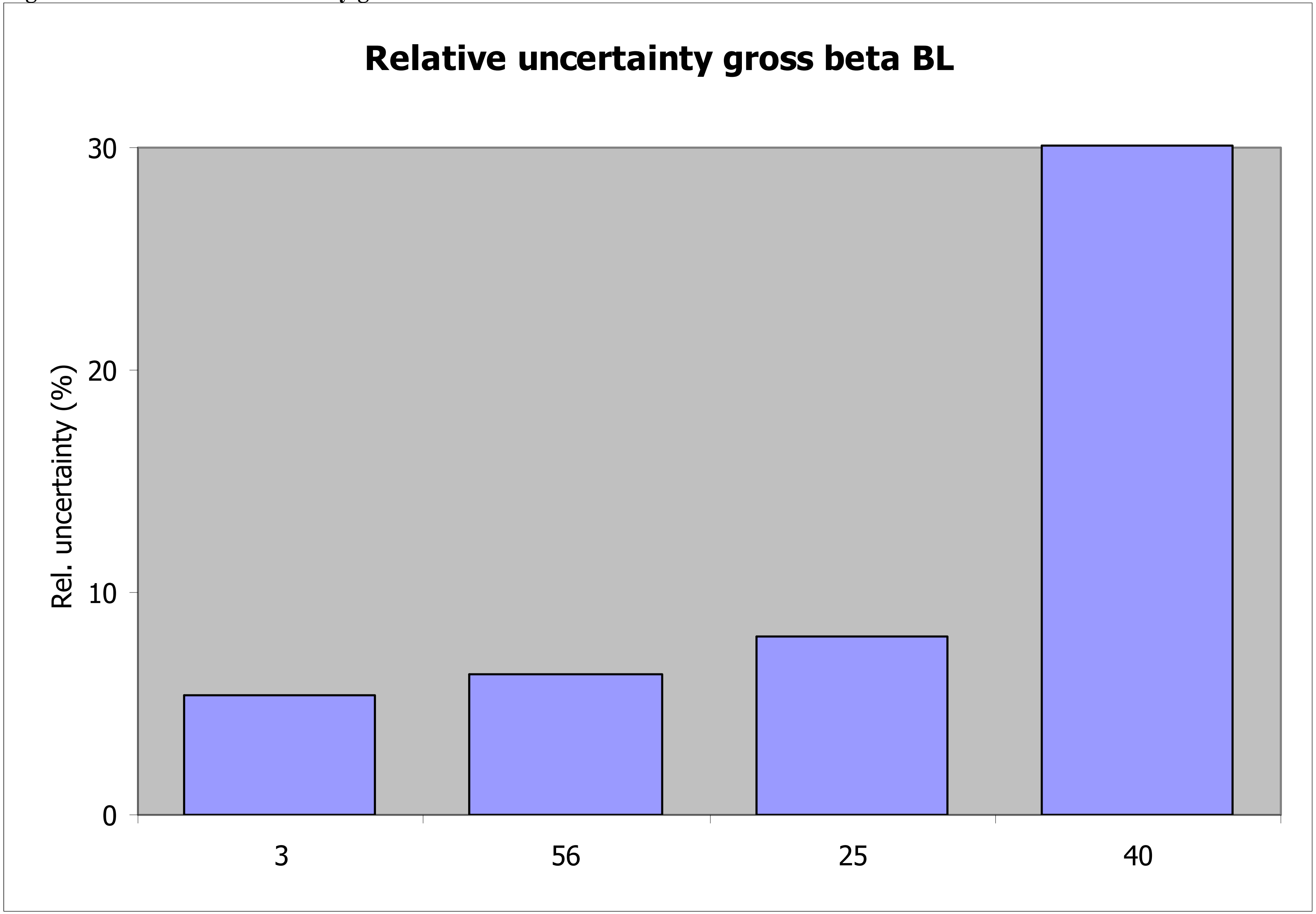


Figure 23D – Kiri plot gross beta BL

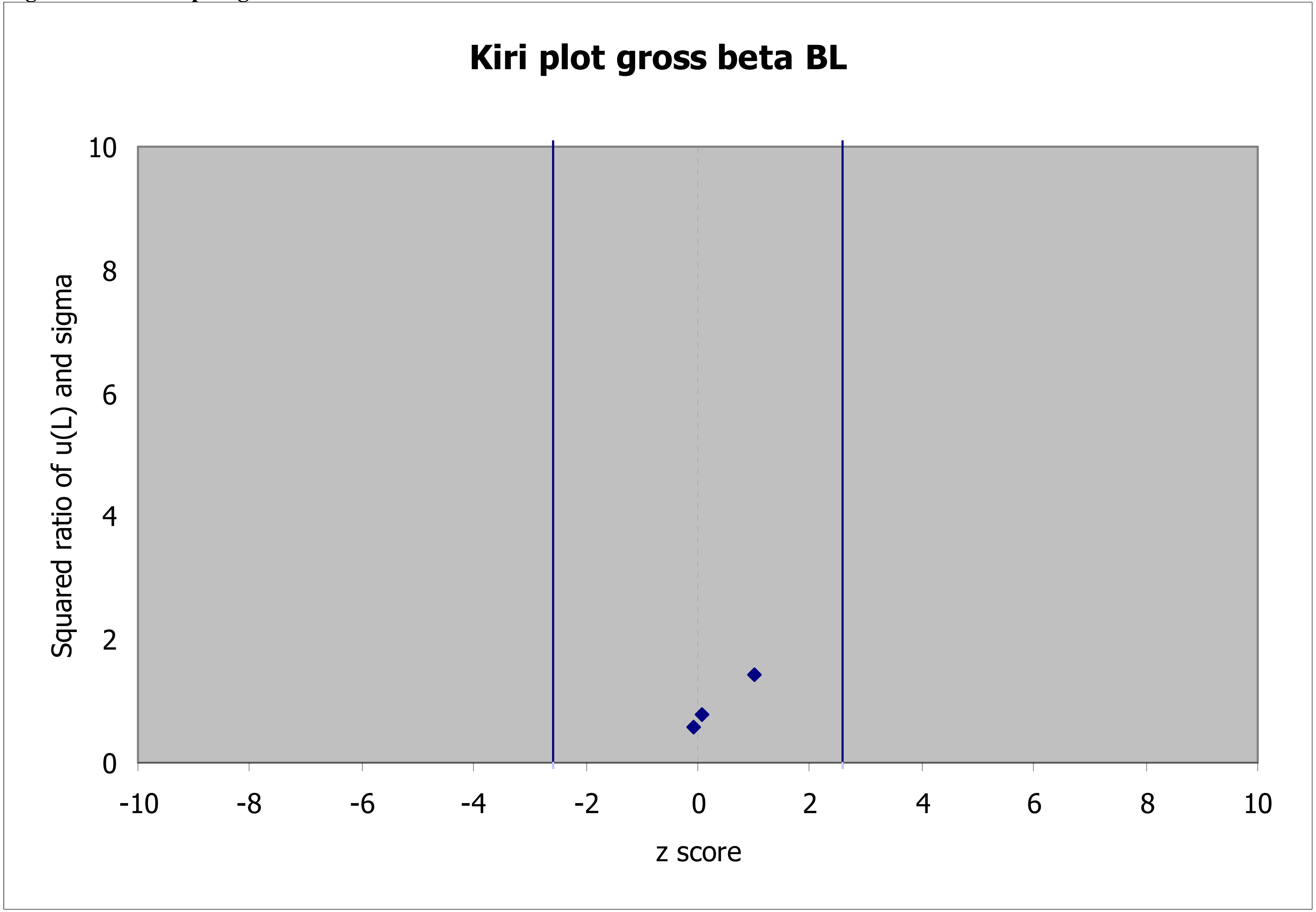


Figure 24A – Deviation H-3 BH

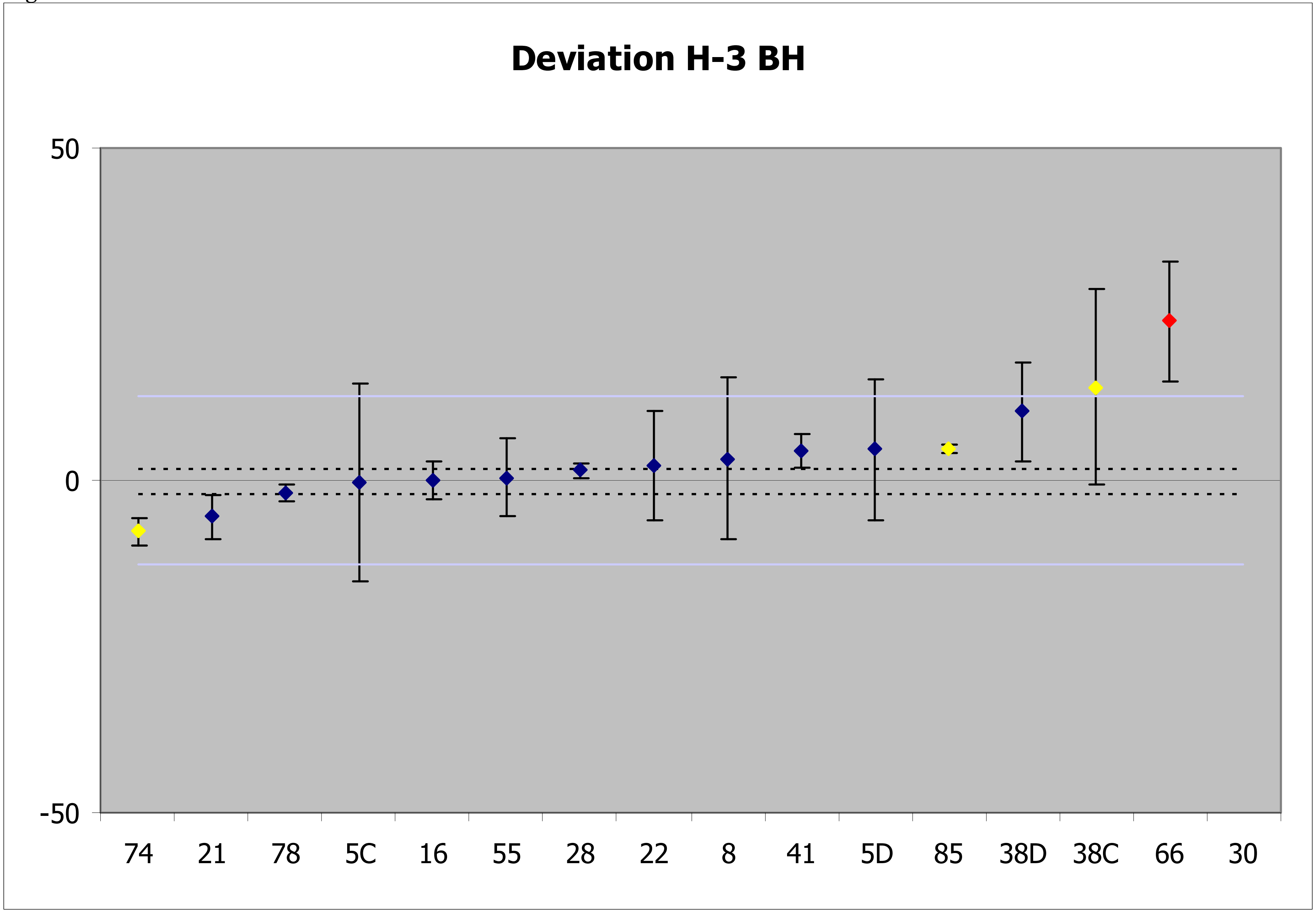


Figure 24B – Zeta score H-3 BH

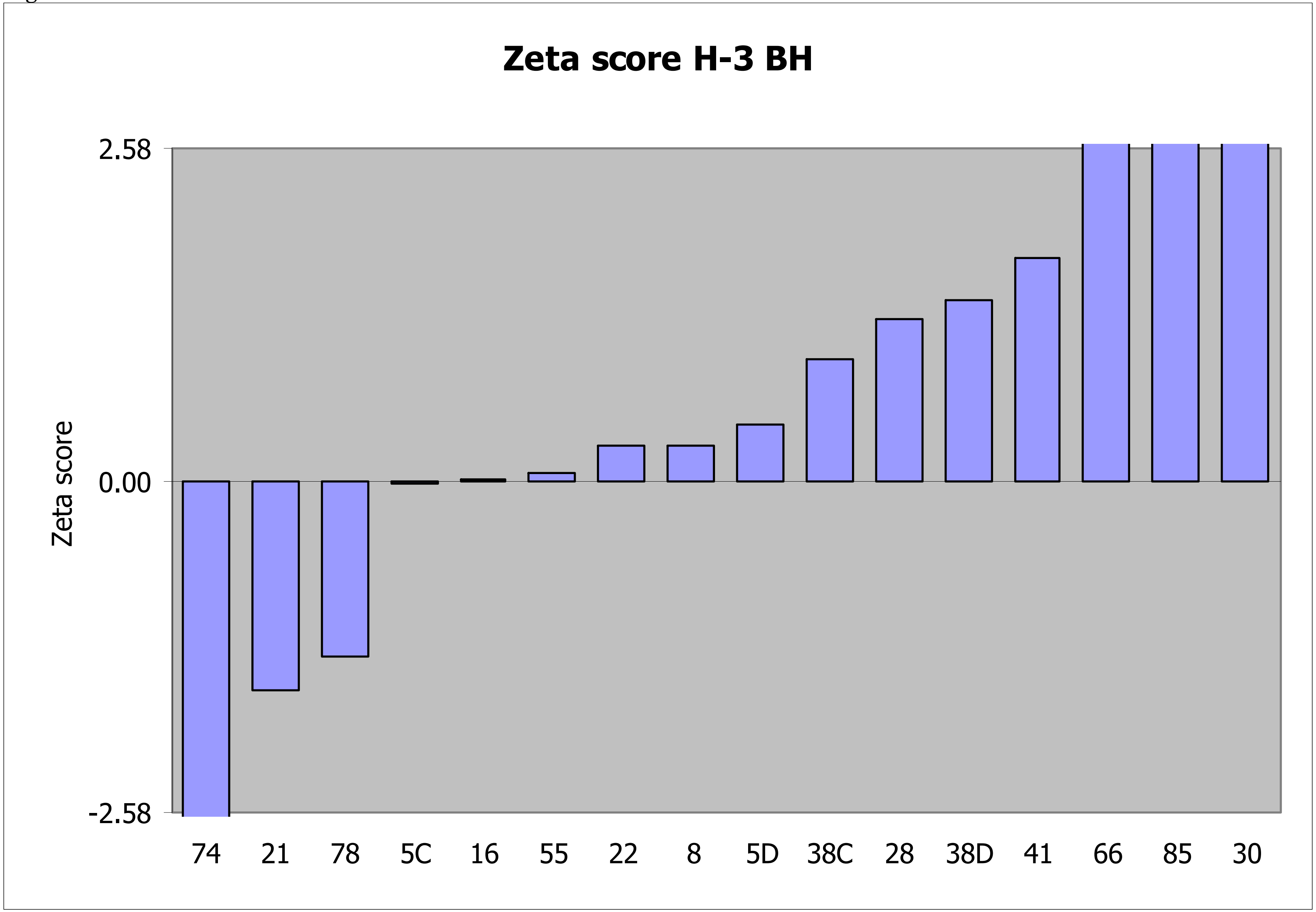


Figure 24C – Relative uncertainty H-3 BH

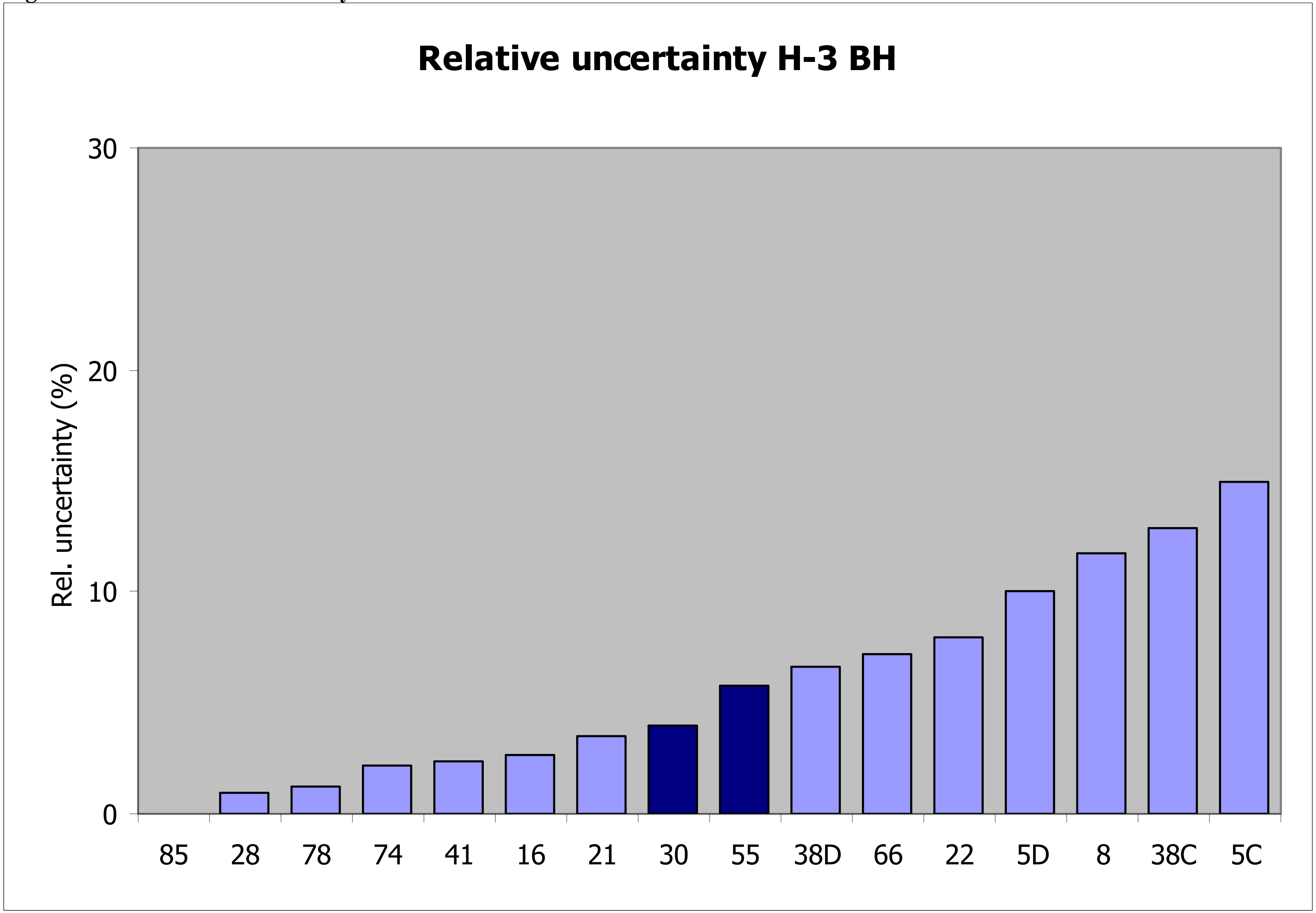


Figure 24D – Kiri plot H-3 BH

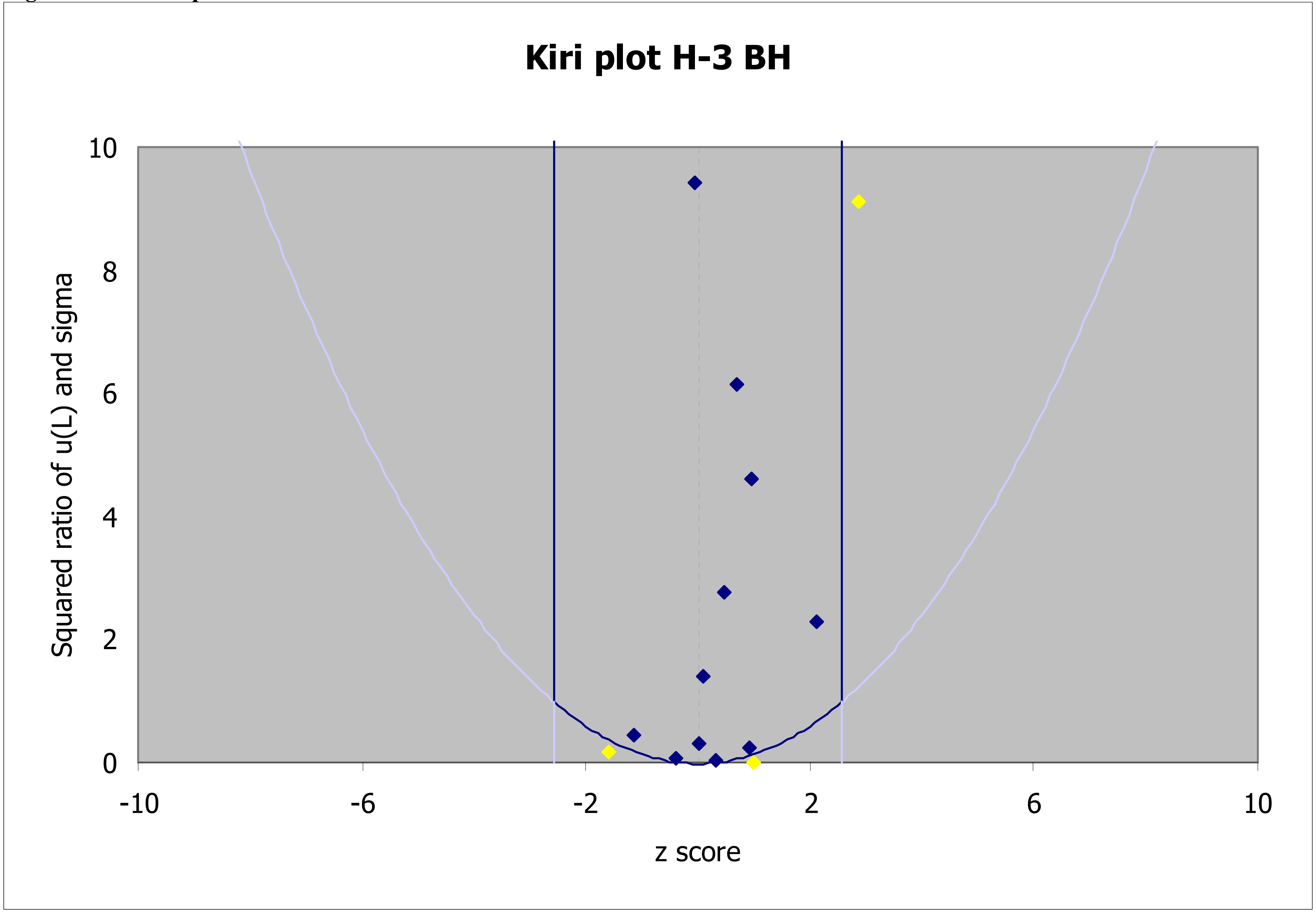


Figure 25A – Deviation Fe-55 BH

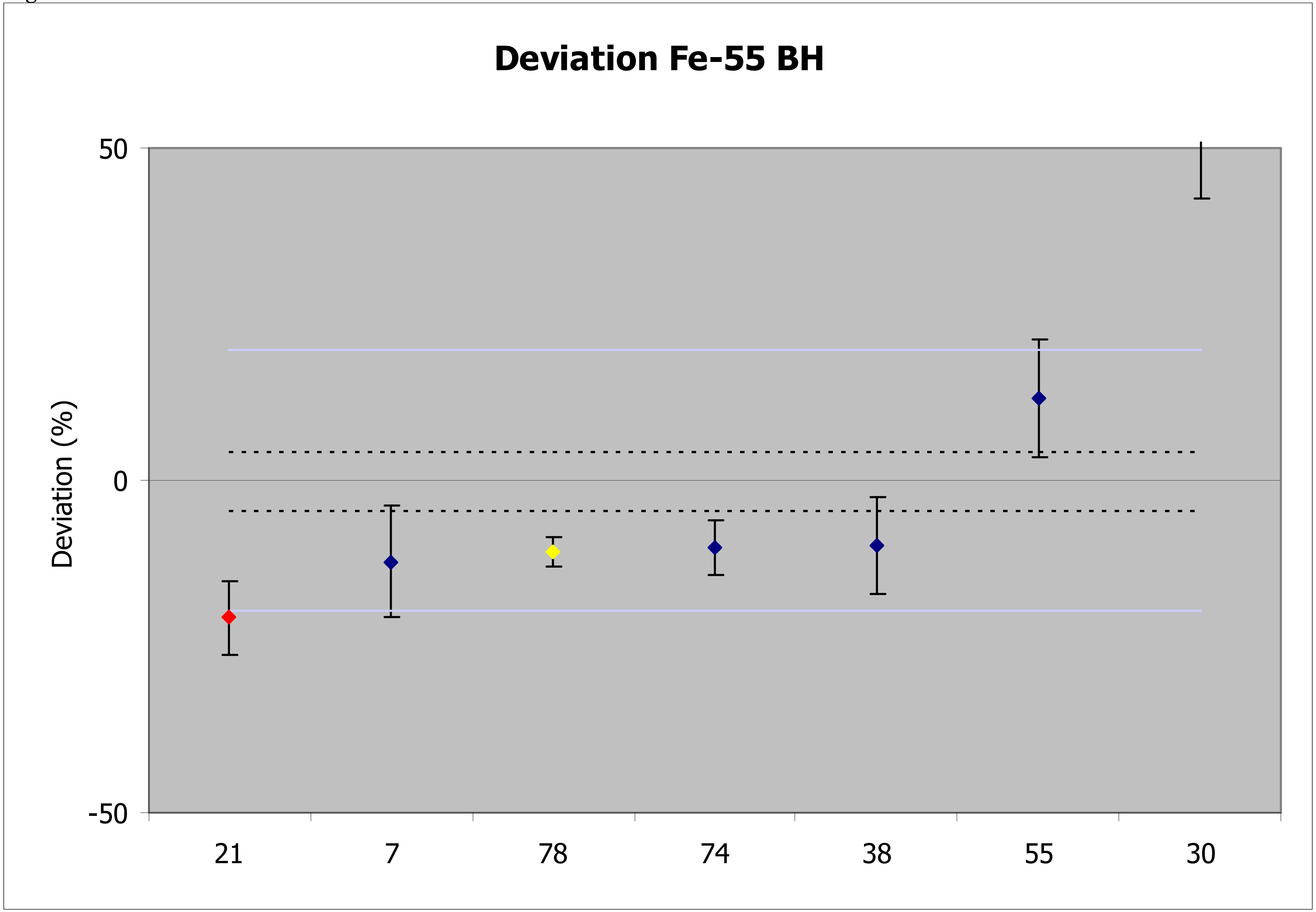


Figure 25B – Zeta score Fe-55 BH

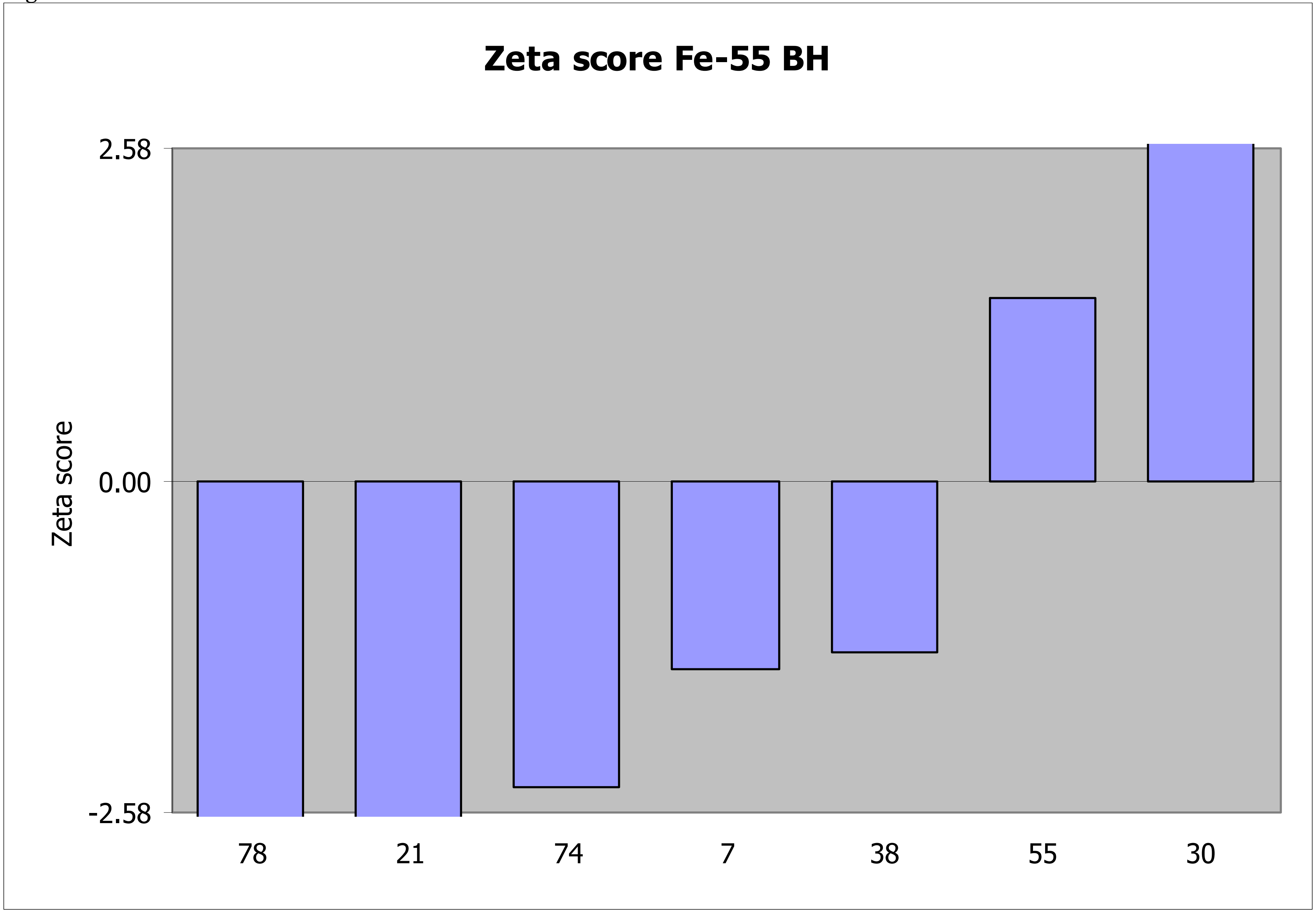


Figure 25C – Relative uncertainty Fe-55 BH

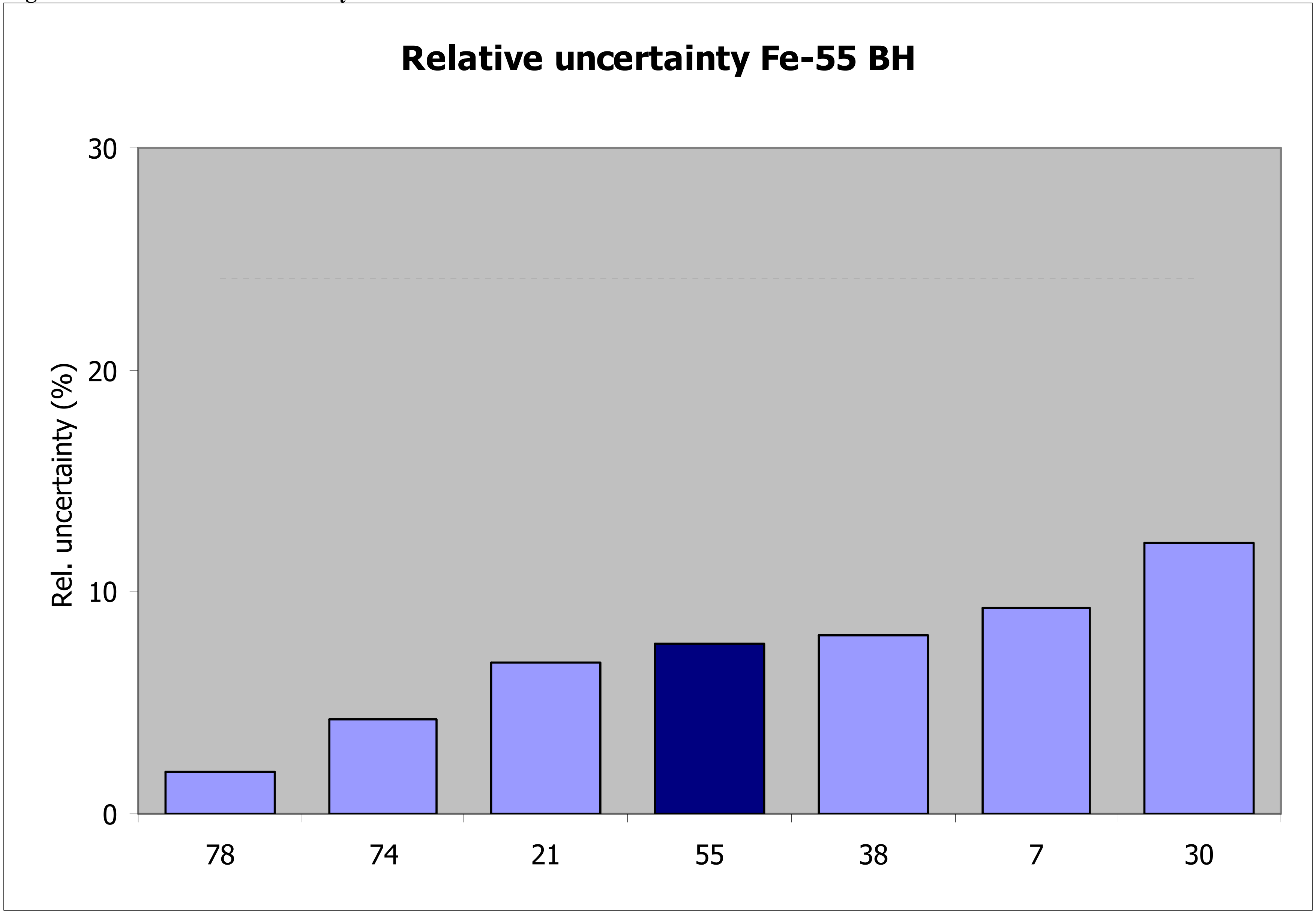


Figure 25D – Kiri plot Fe-55 BH

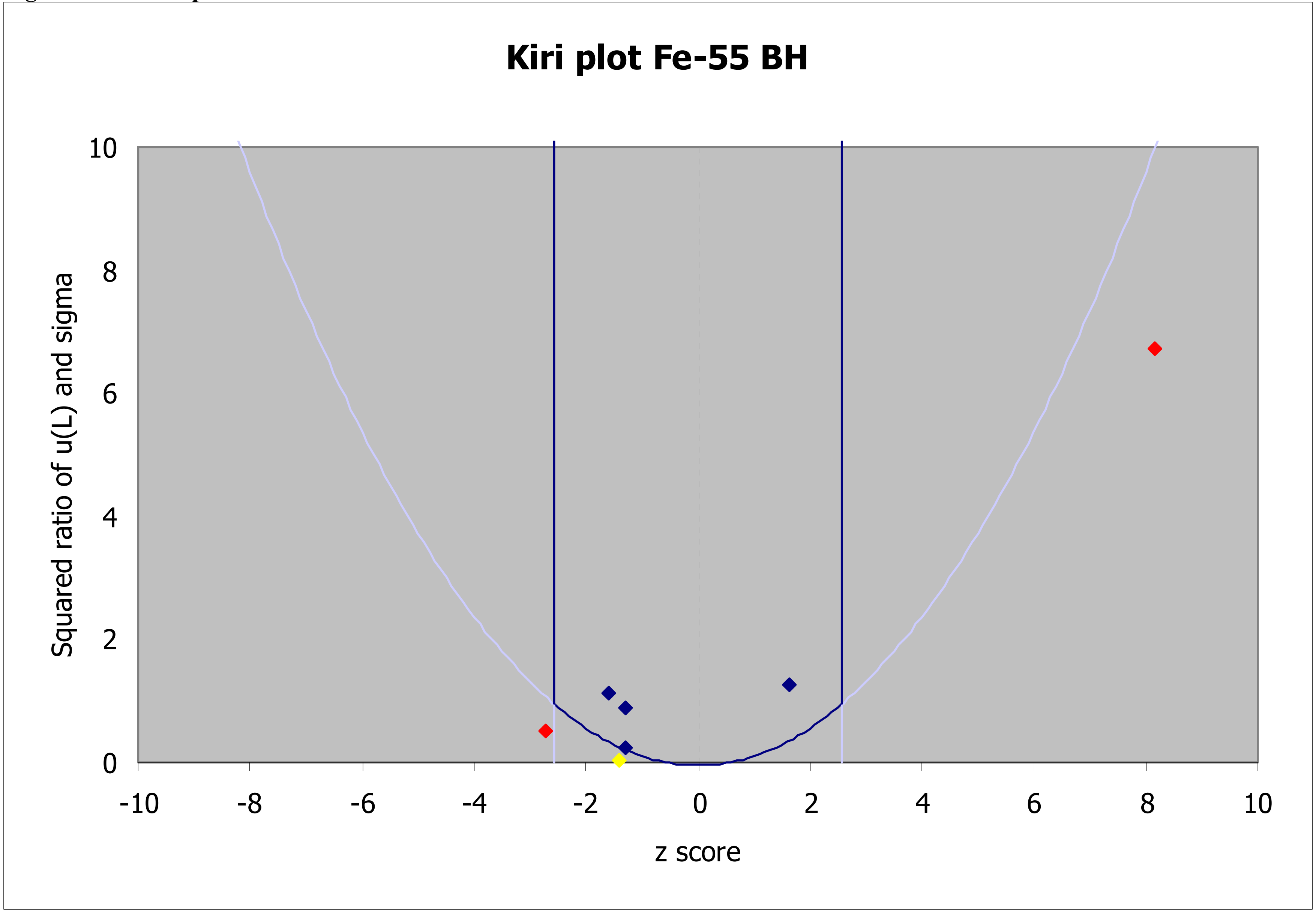


Figure 26A – Deviation Ni-63 BH

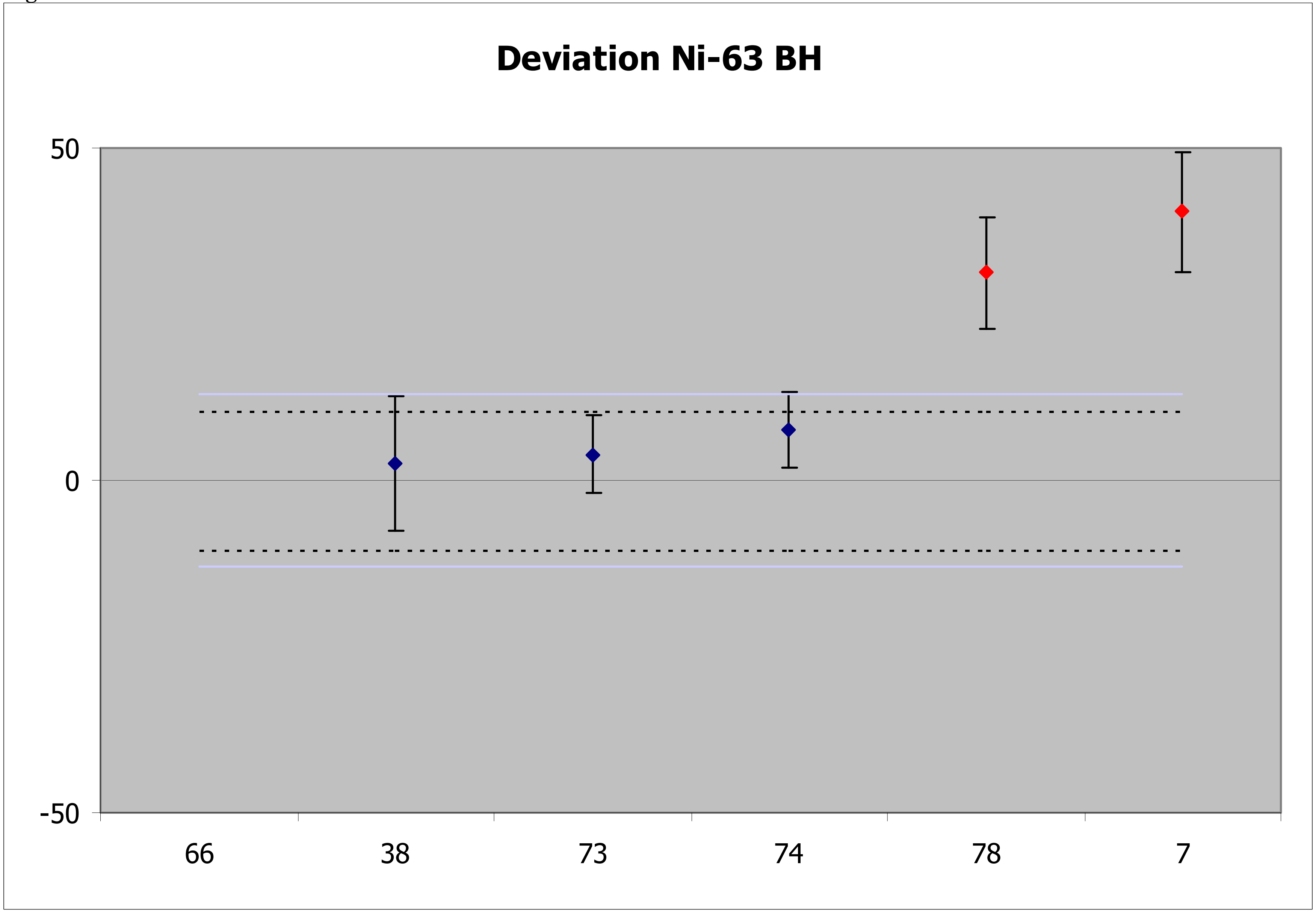


Figure 26B – Zeta score Ni-63 BH

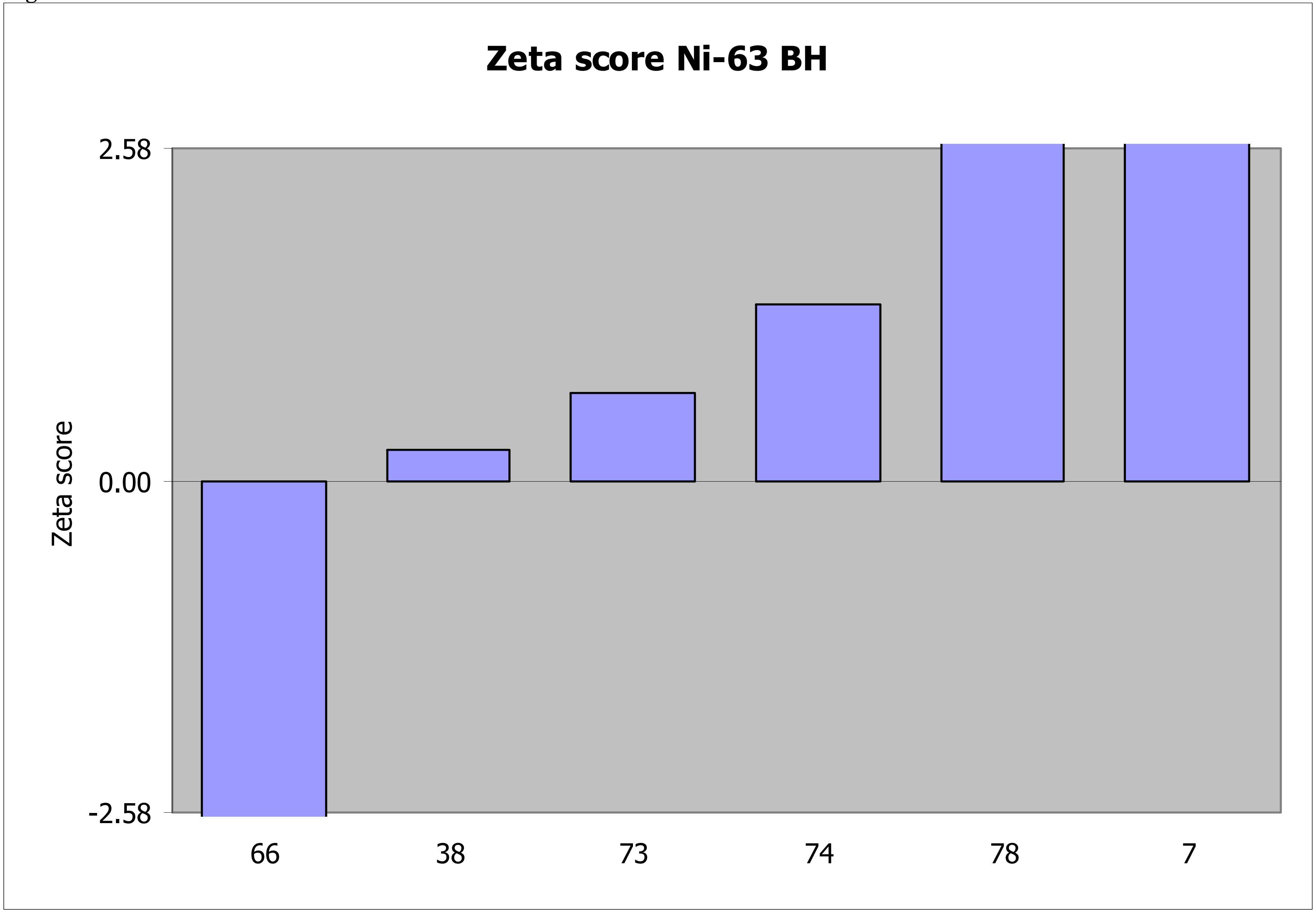


Figure 26C – Relative uncertainty Ni-63 BH

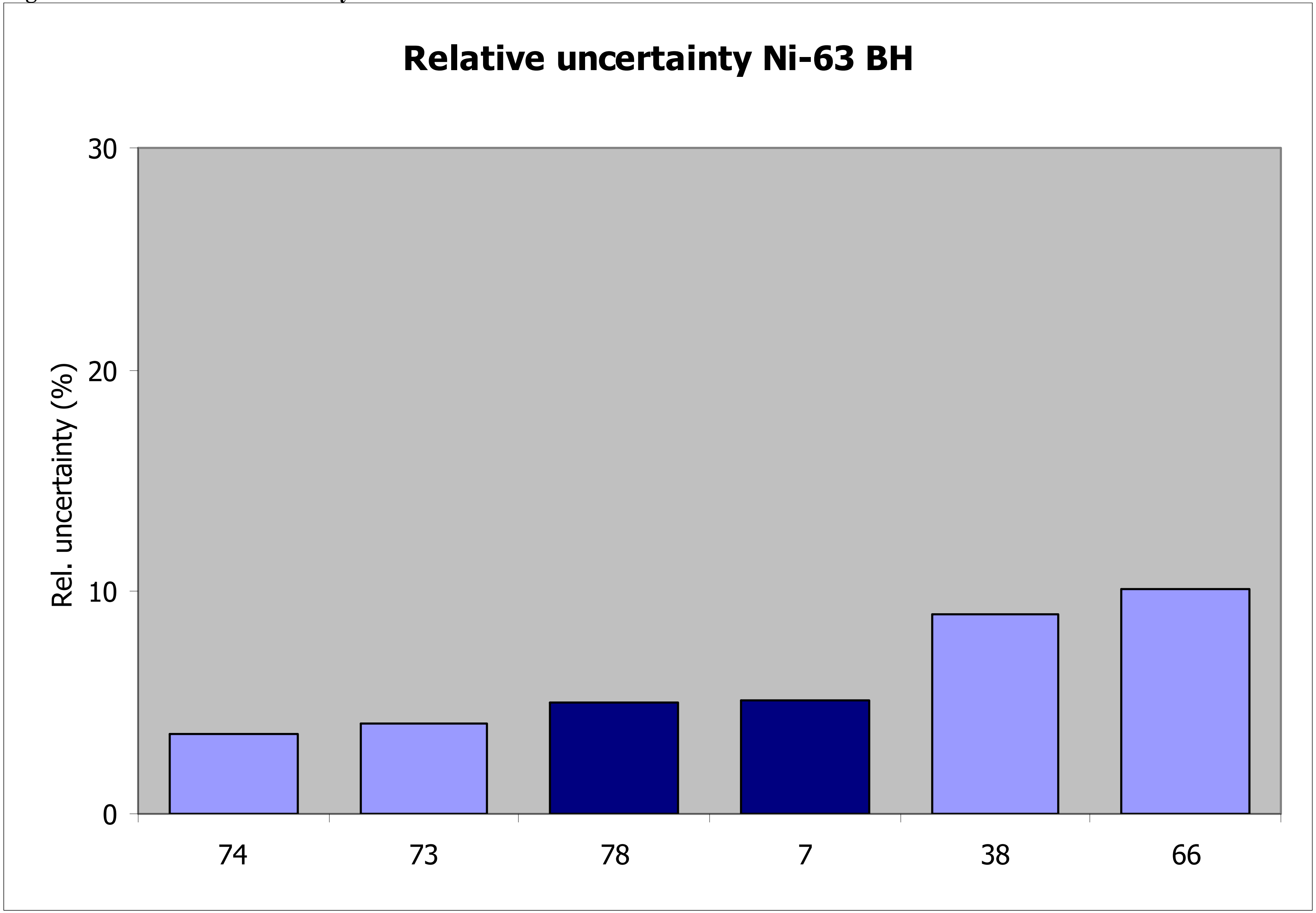


Figure 26D – Kiri plot Ni-63 BH

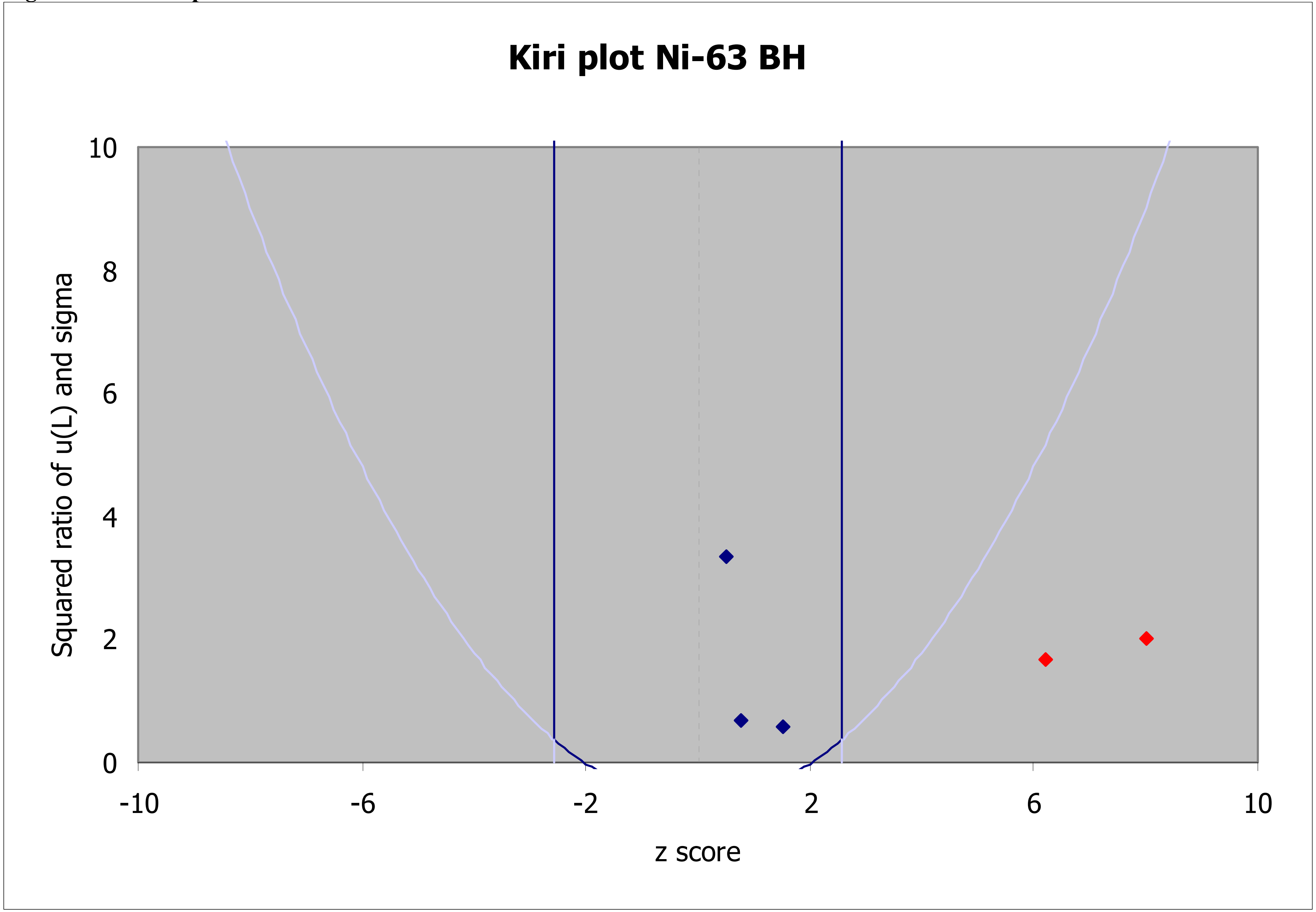


Figure 27A – Deviation Sr-89 BH

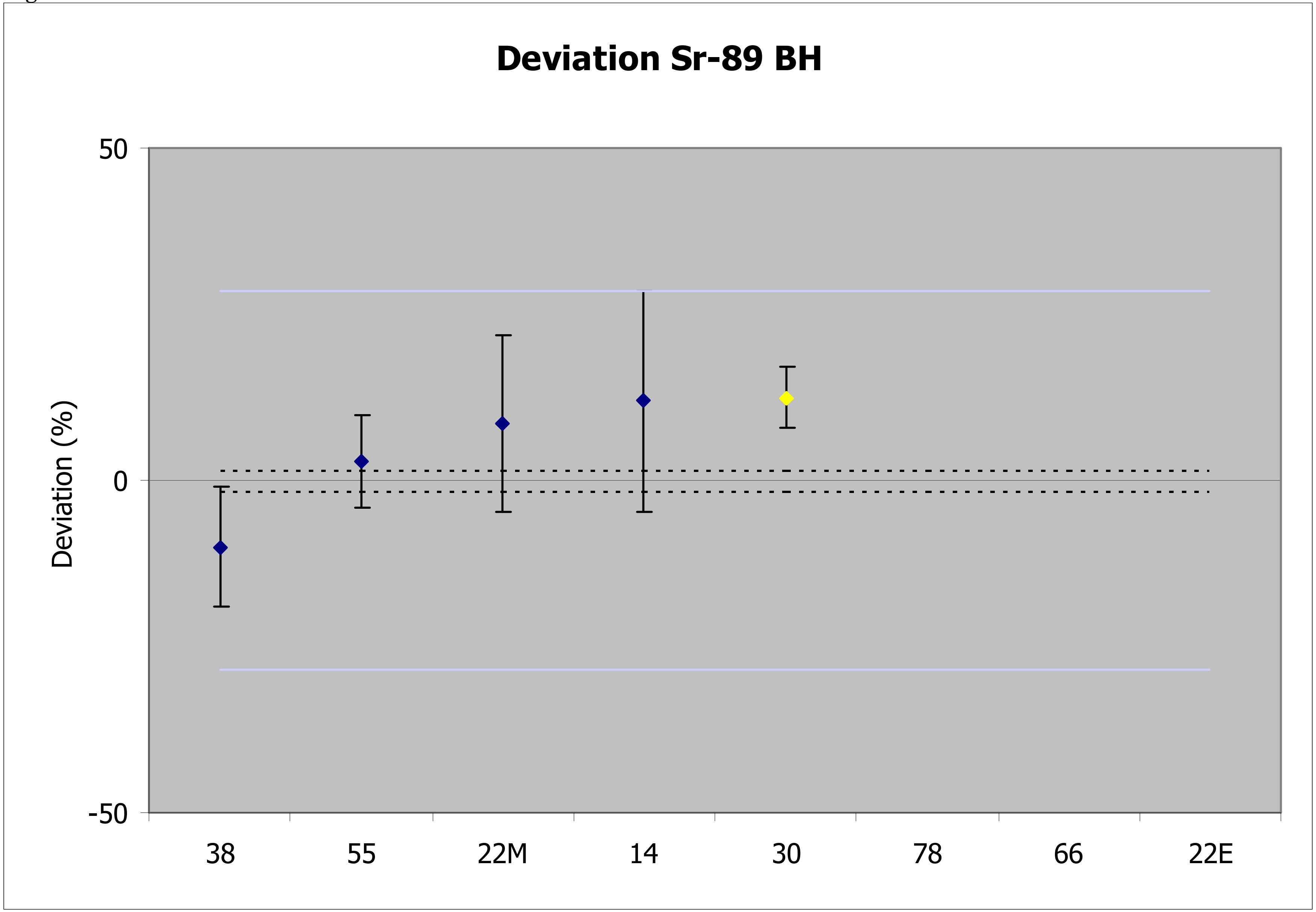


Figure 27B – Zeta score Sr-89 BH

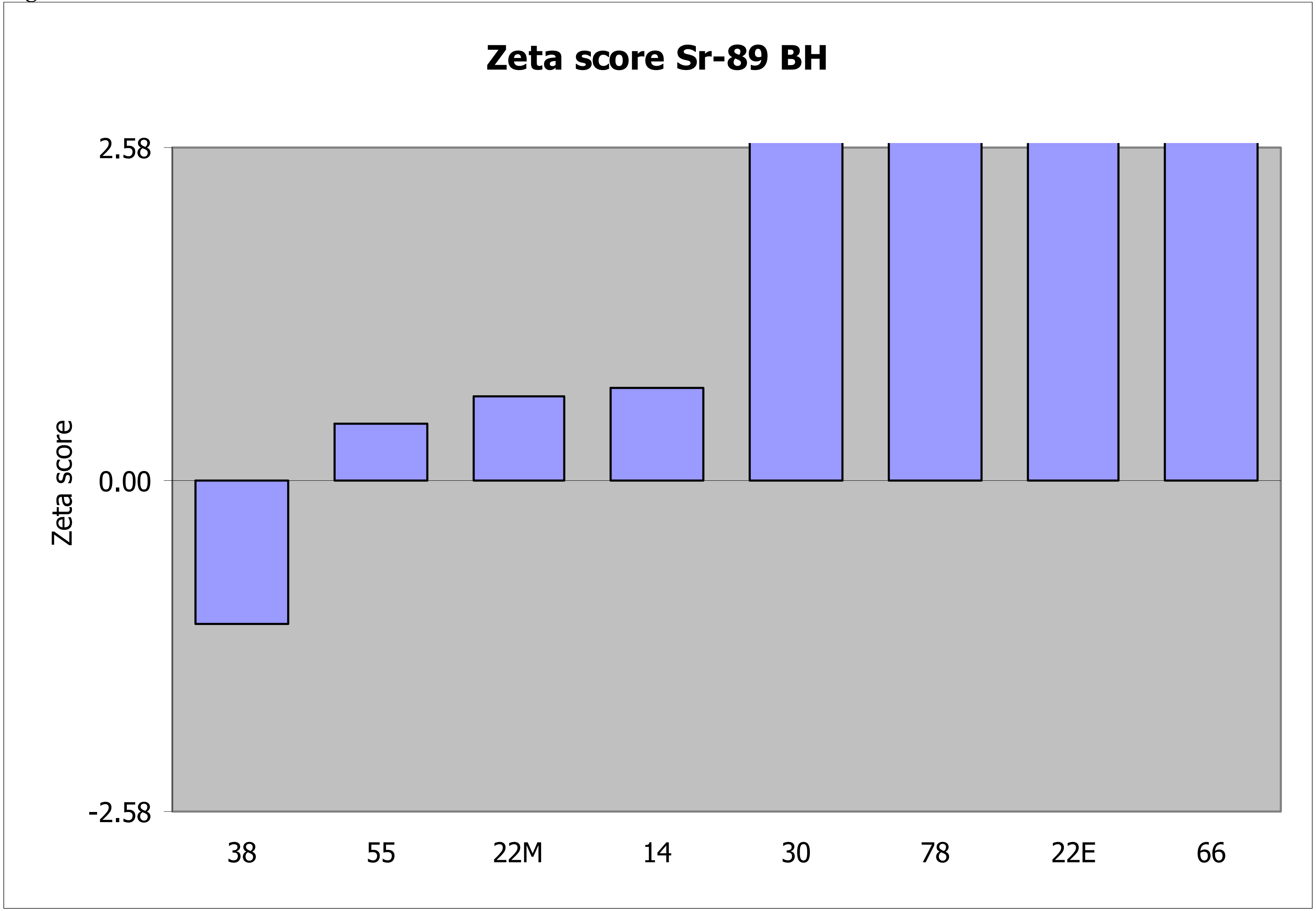


Figure 27C – Relative uncertainty Sr-89 BH

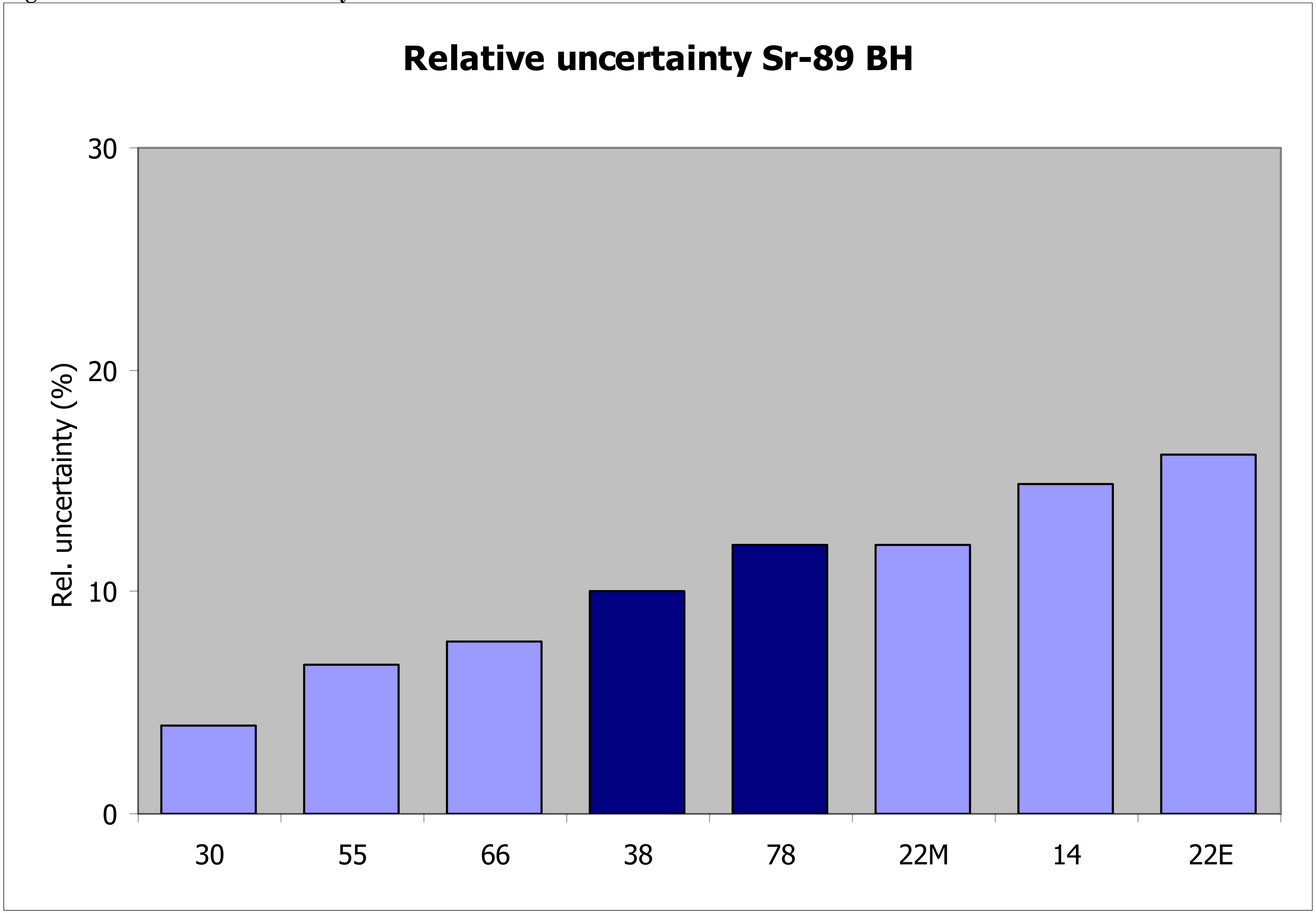


Figure 27D – Kiri plot Sr-89 BH

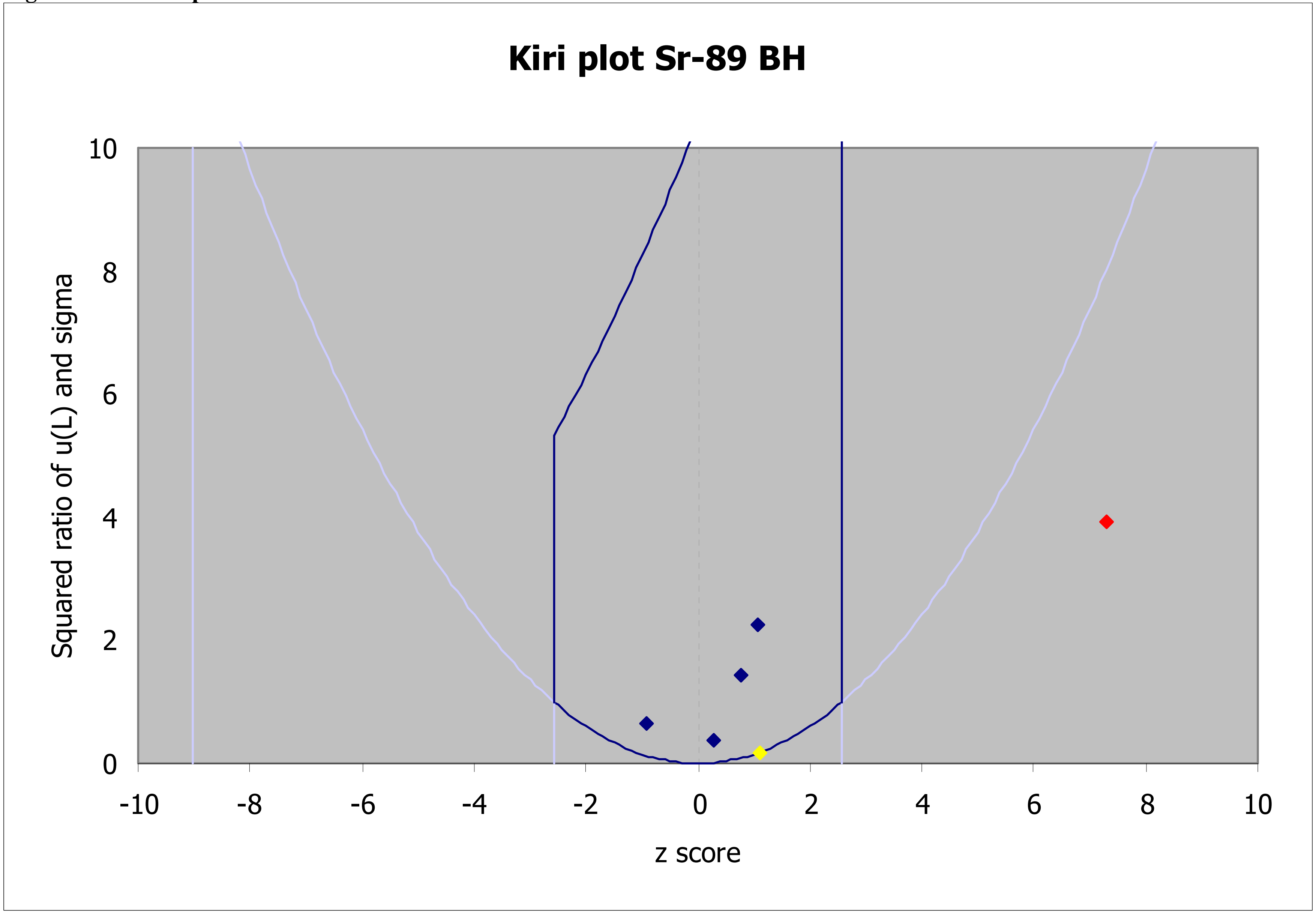


Figure 28A – Deviation Sr-90 BH

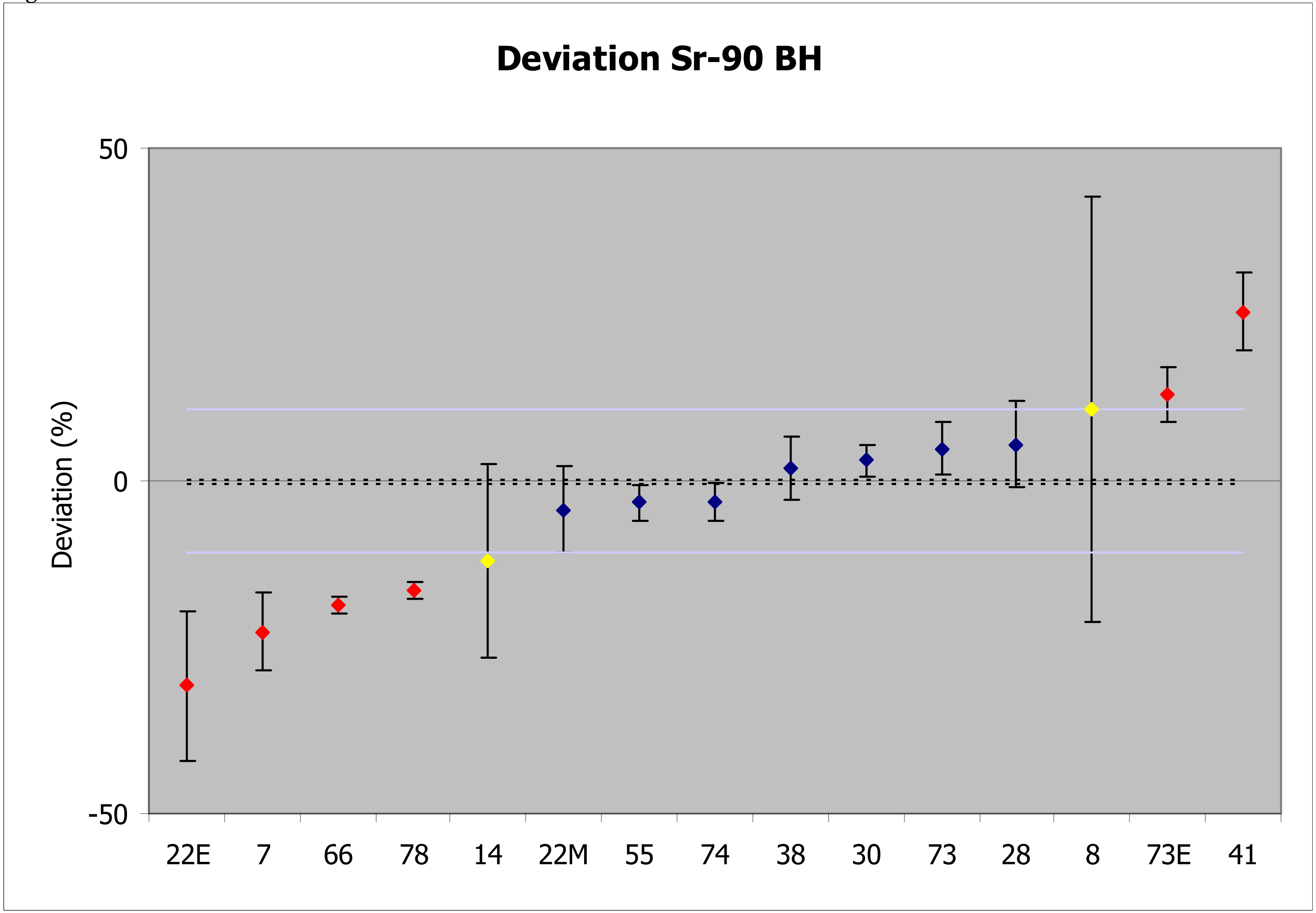


Figure 28B – Zeta score Sr-90 BH

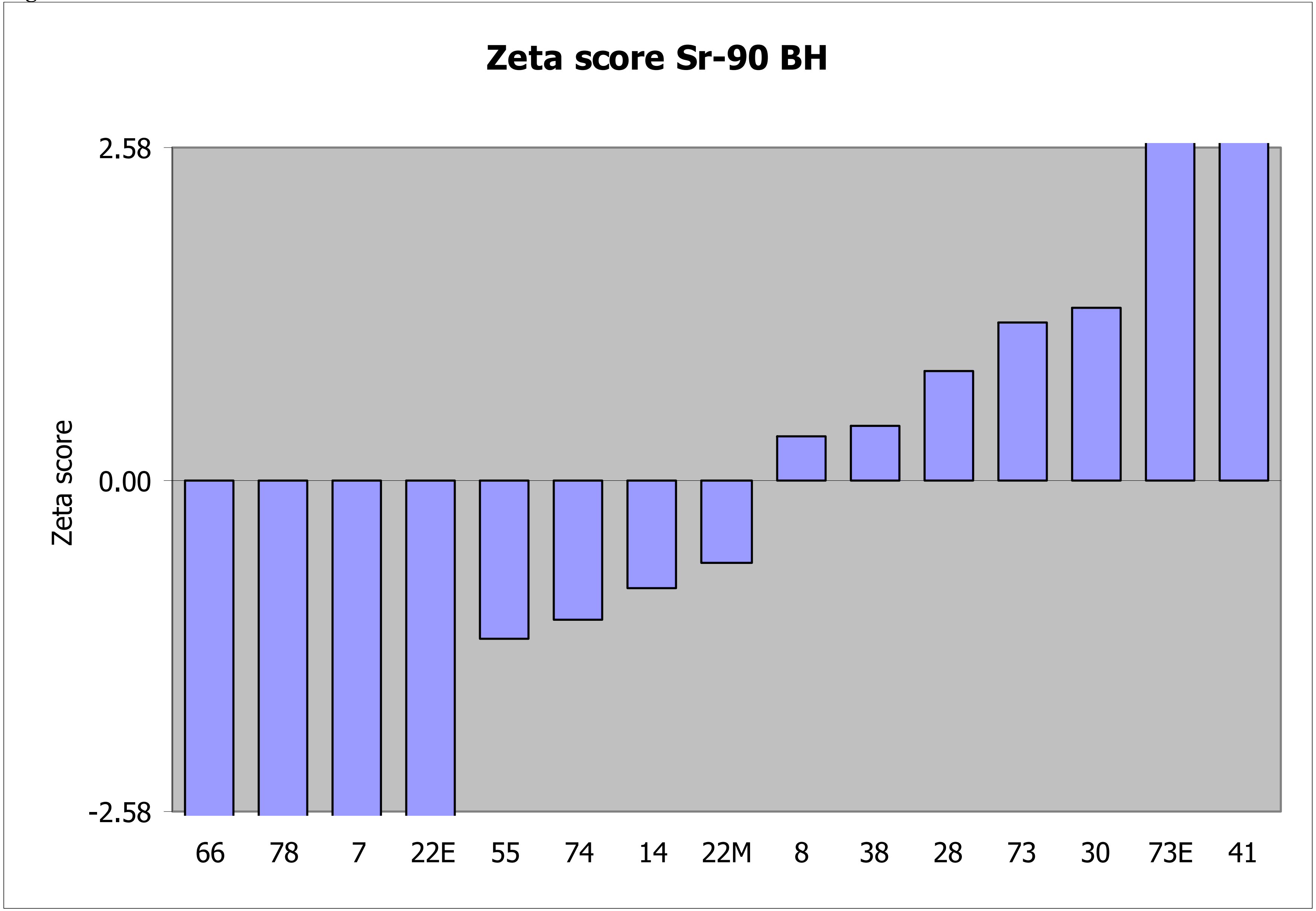


Figure 28C – Relative uncertainty Sr-90 BH

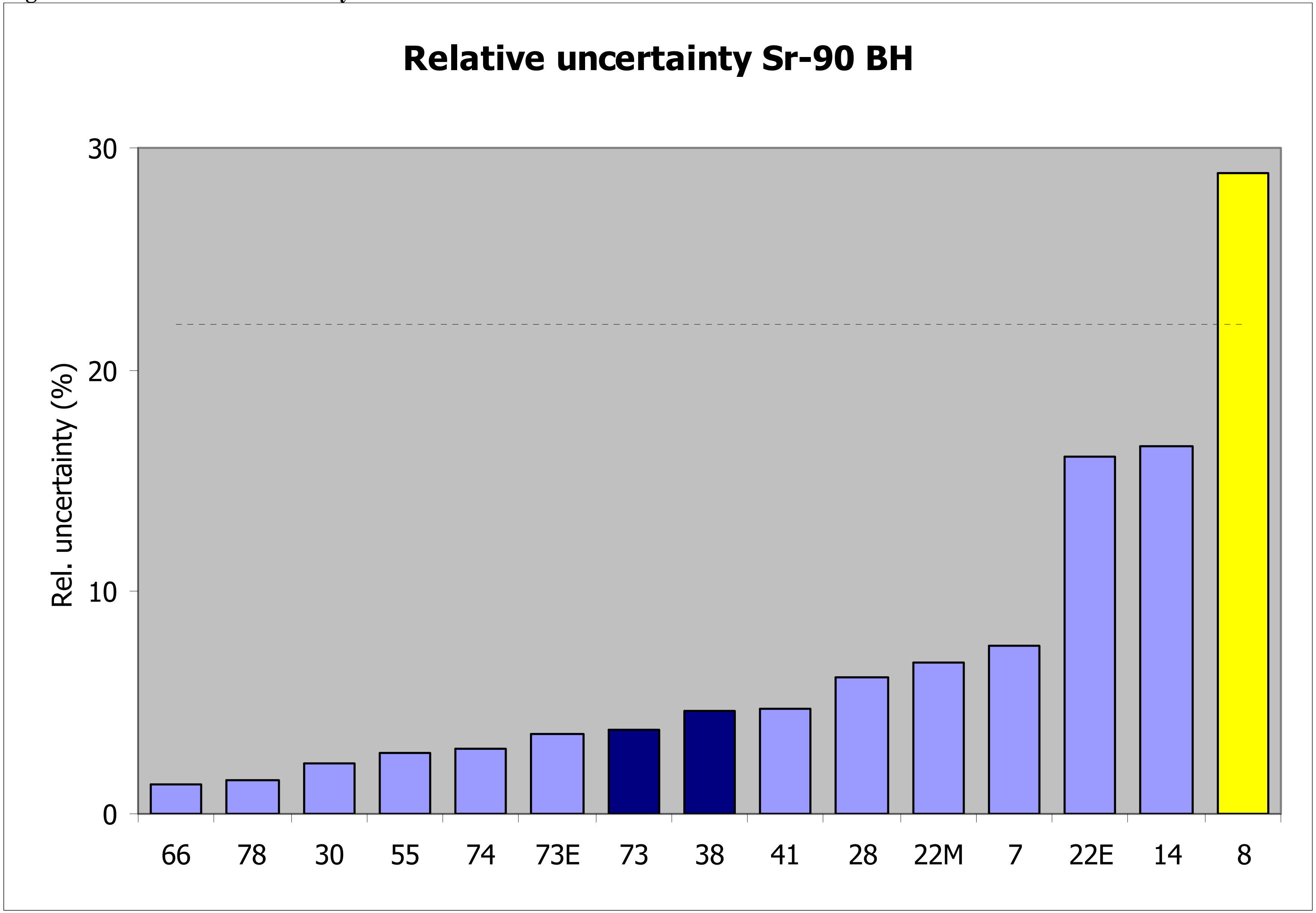


Figure 28D – Kiri plot Sr-90 BH

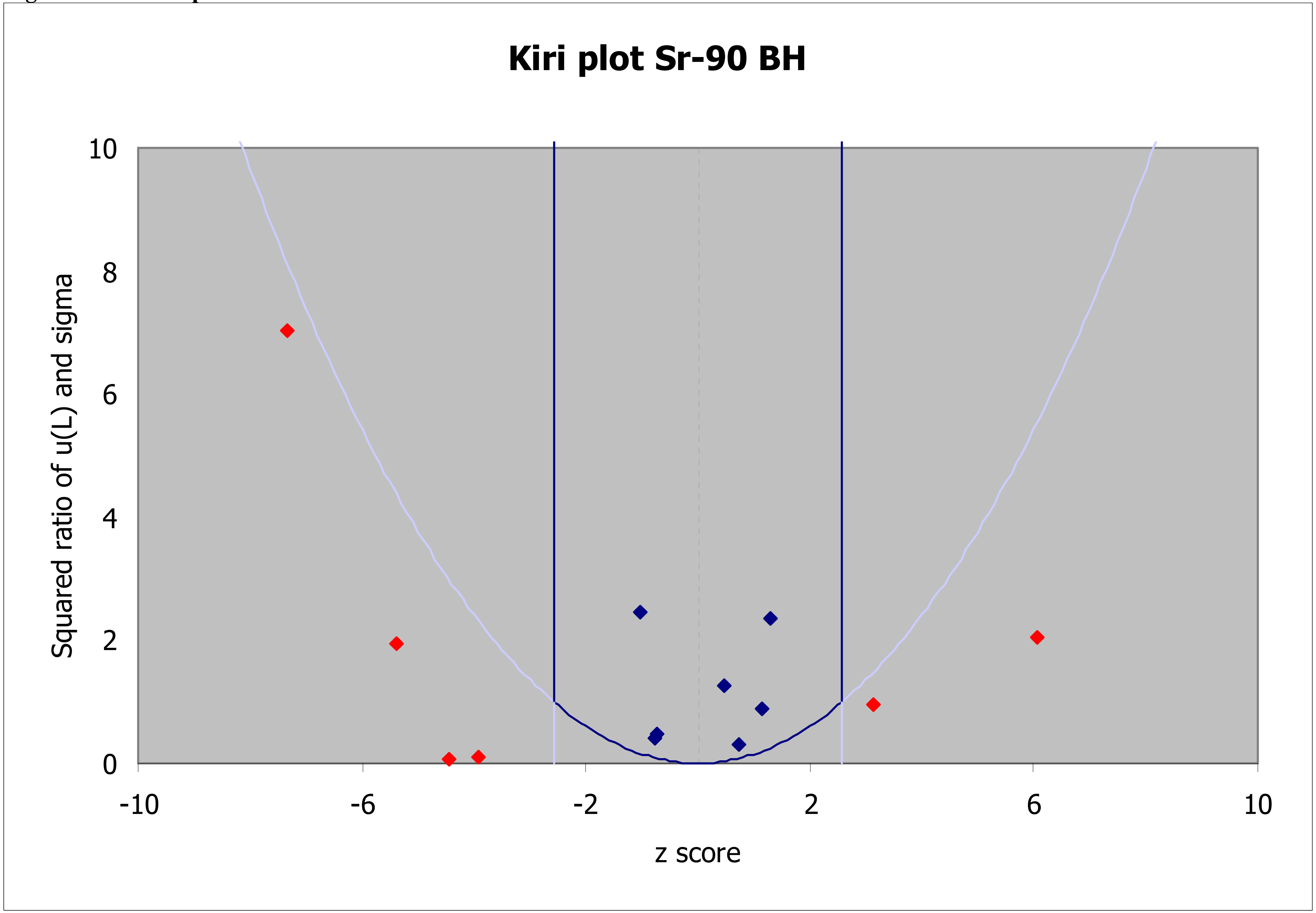


Figure 29A – Deviation Tc-99 BH

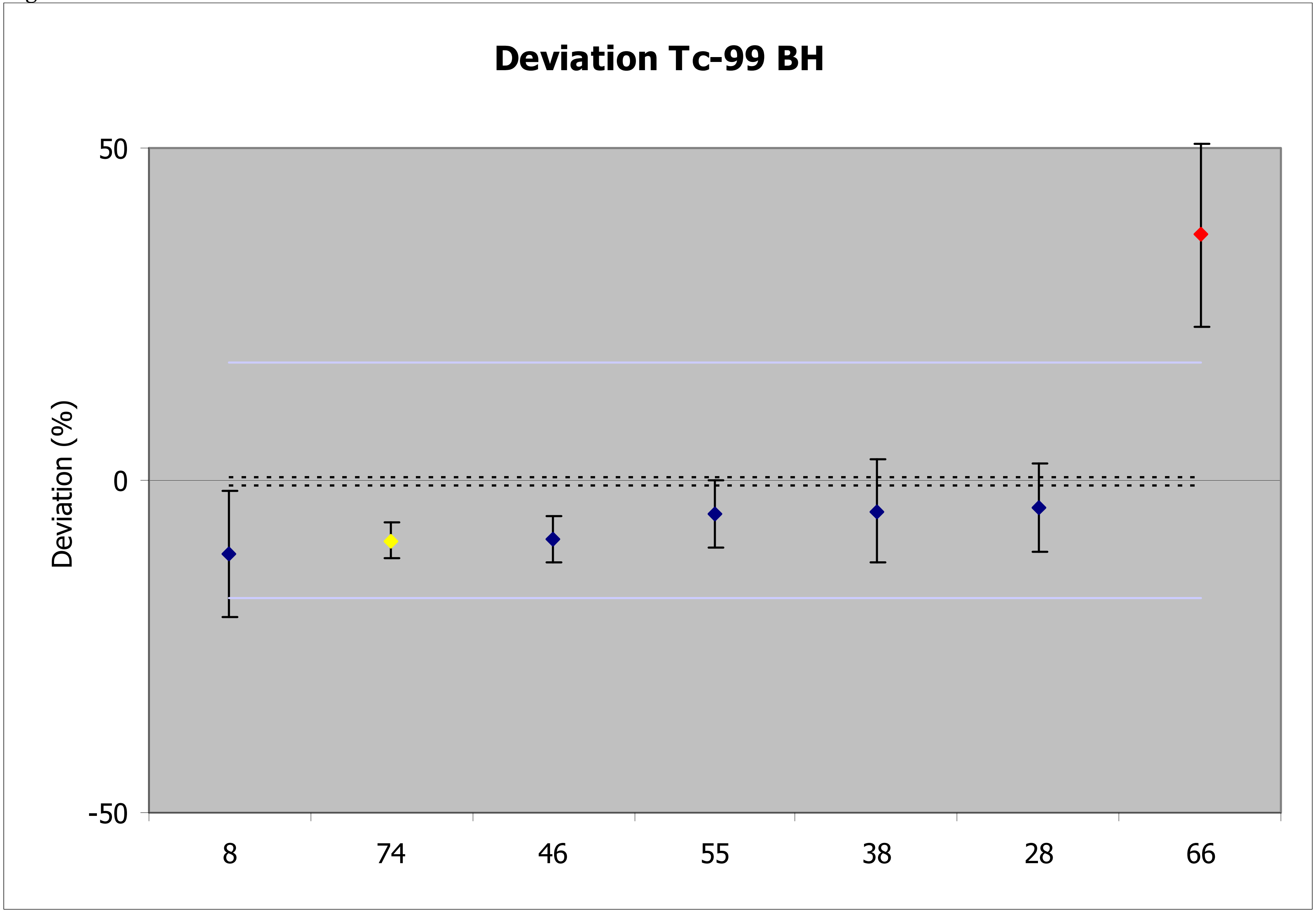


Figure 29B – Zeta score Tc-99 BH

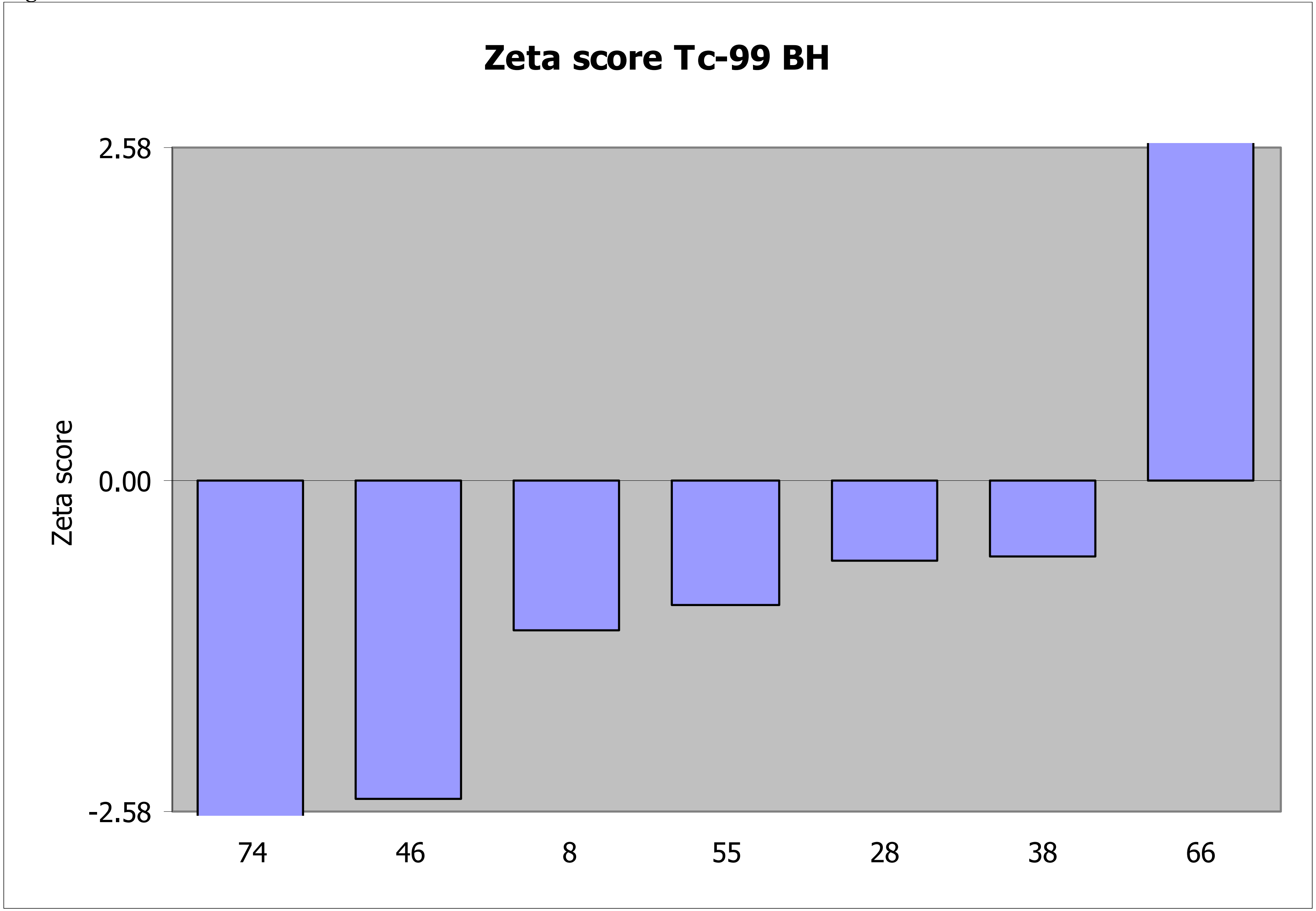


Figure 29C – Relative uncertainty Tc-99 BH

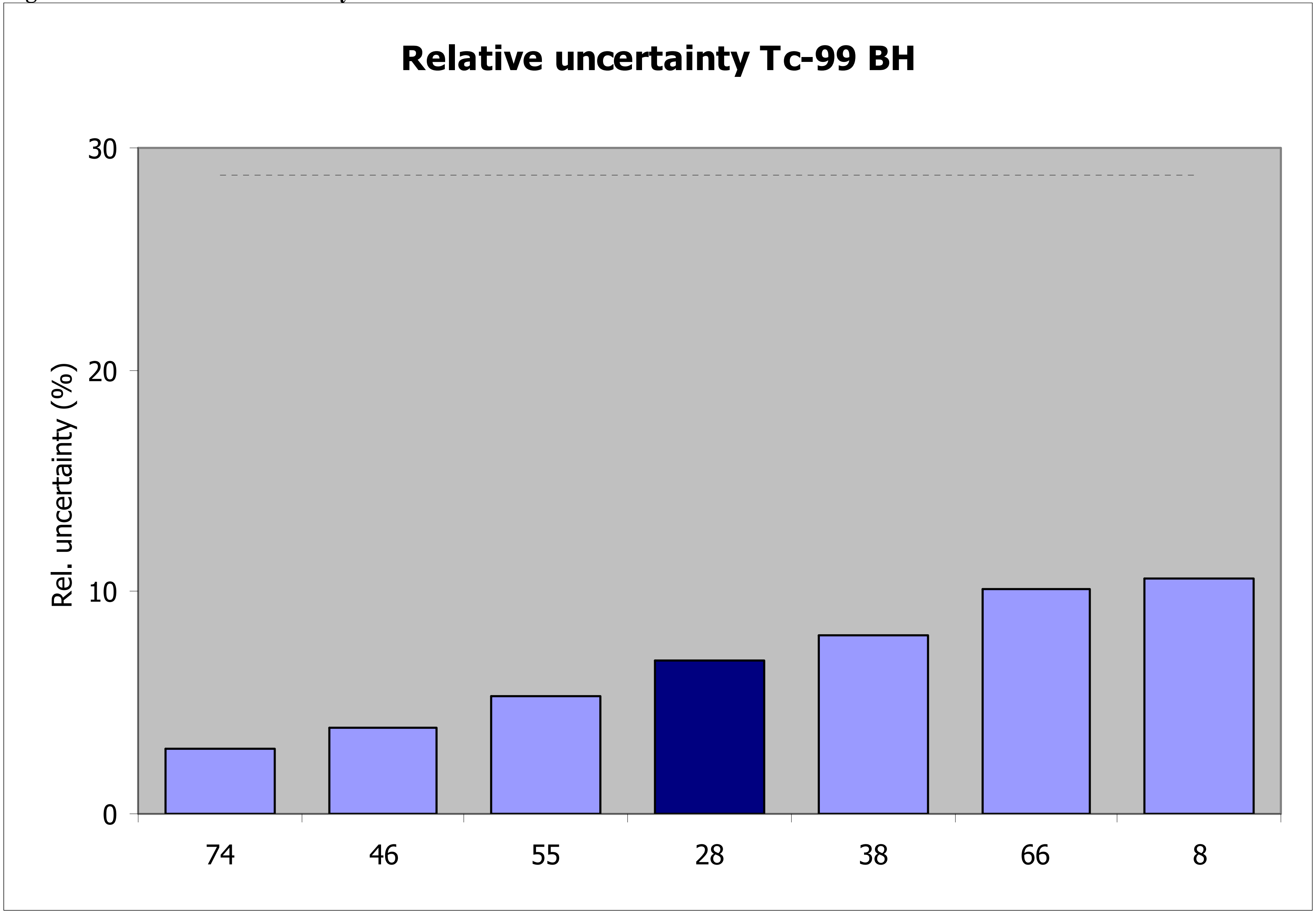


Figure 29D – Kiri plot Tc-99 BH

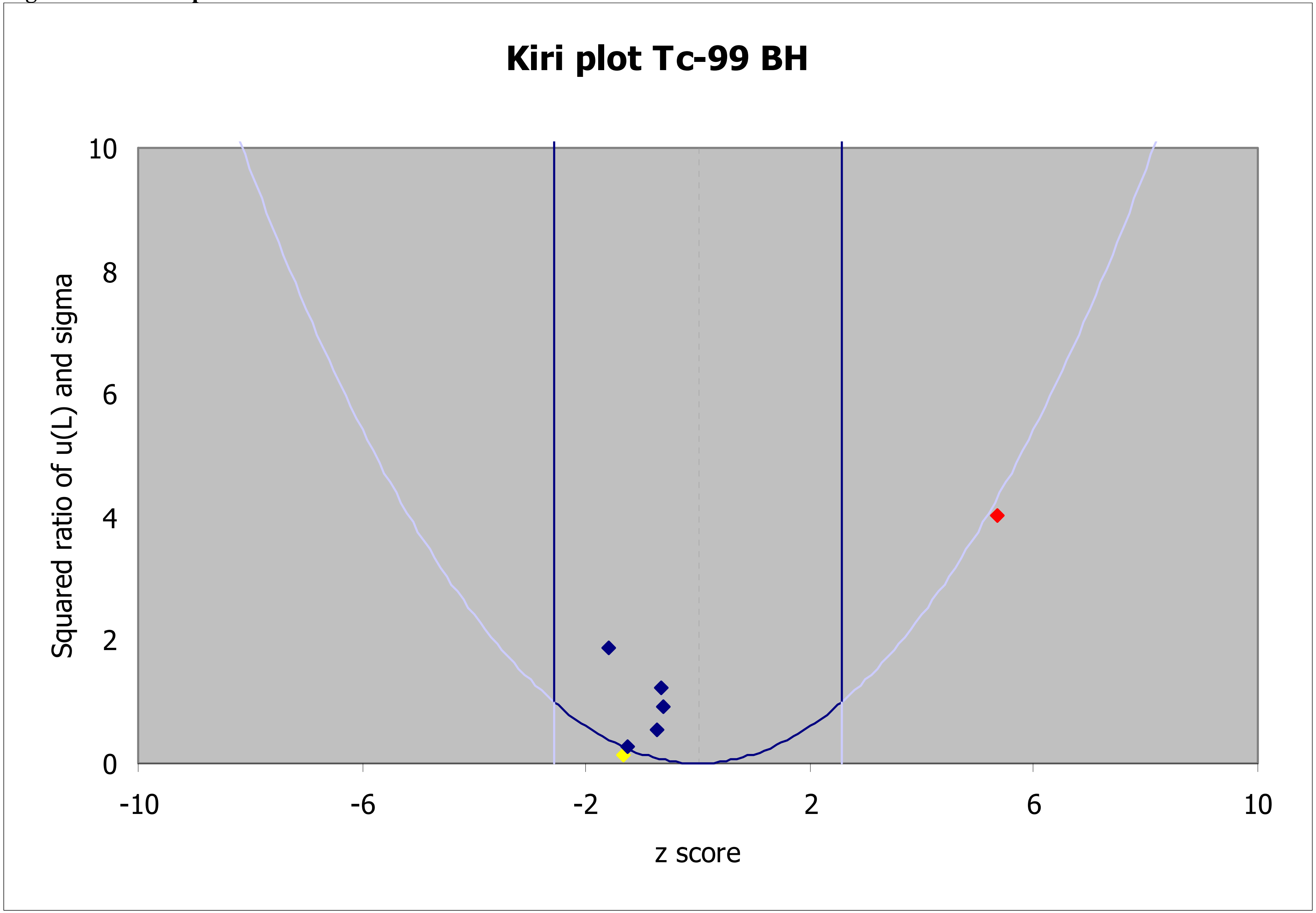


Figure 30A – Deviation gross beta BH

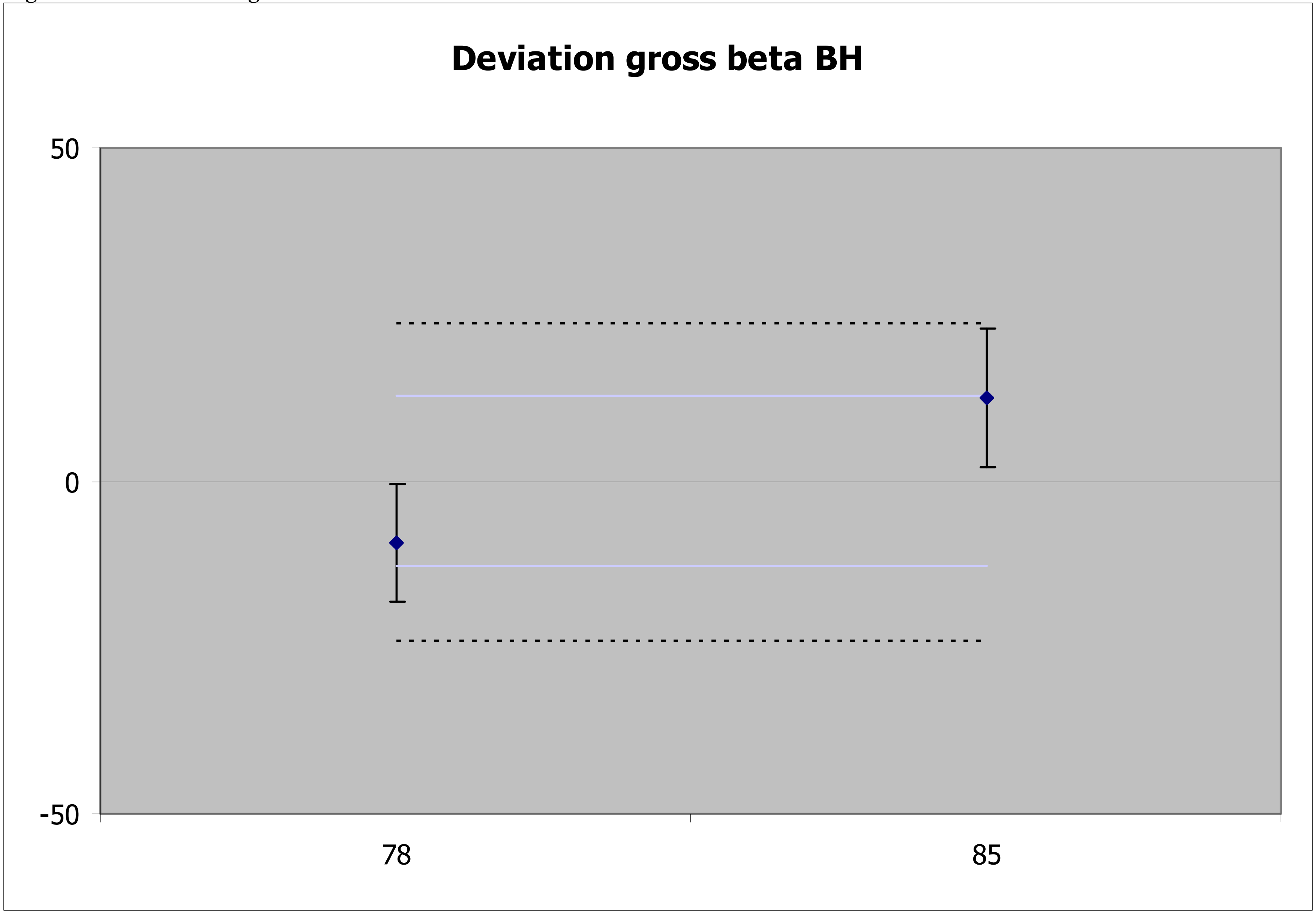


Figure 30B – Zeta score gross beta BH

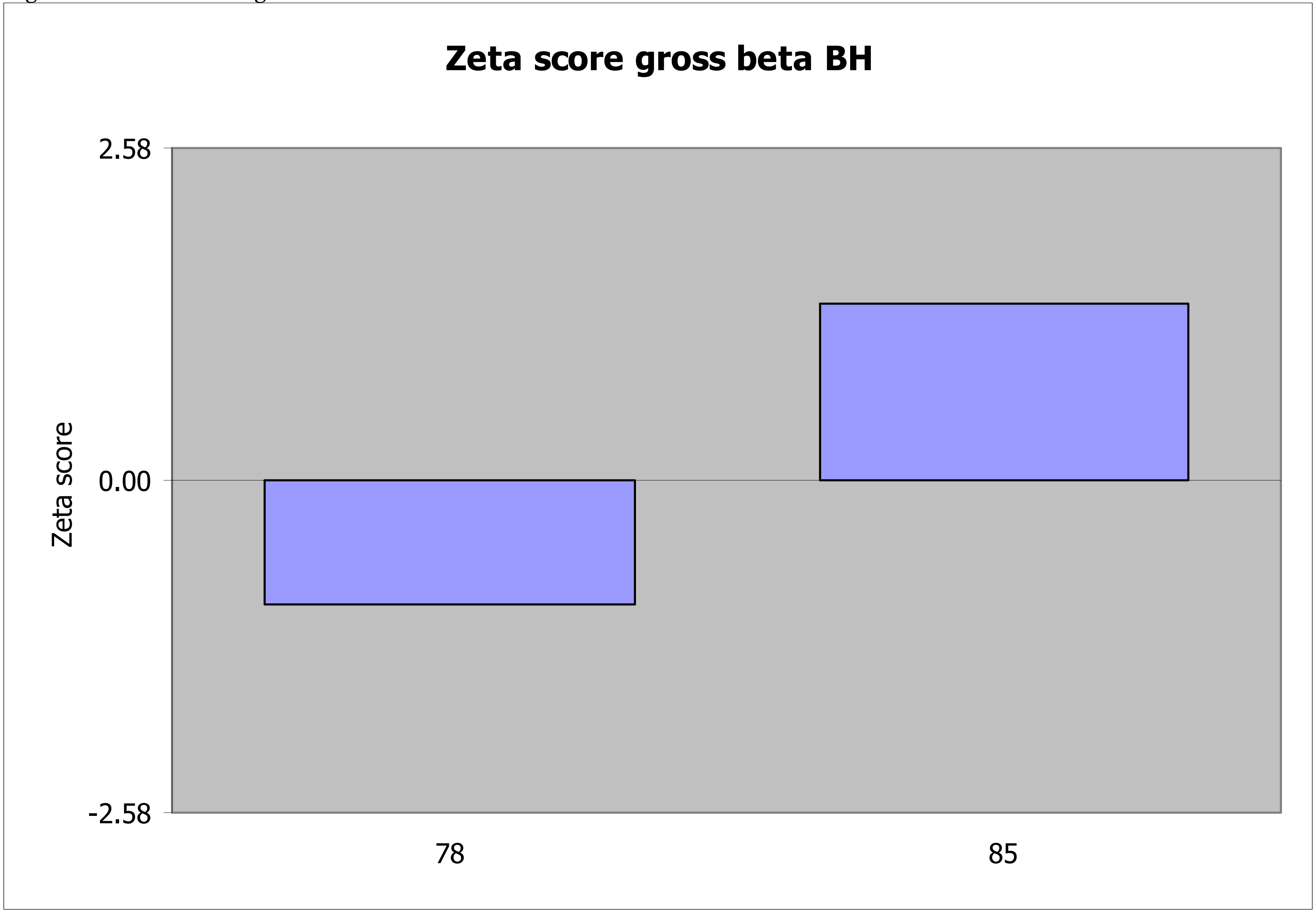


Figure 30C – Relative uncertainty gross beta BH

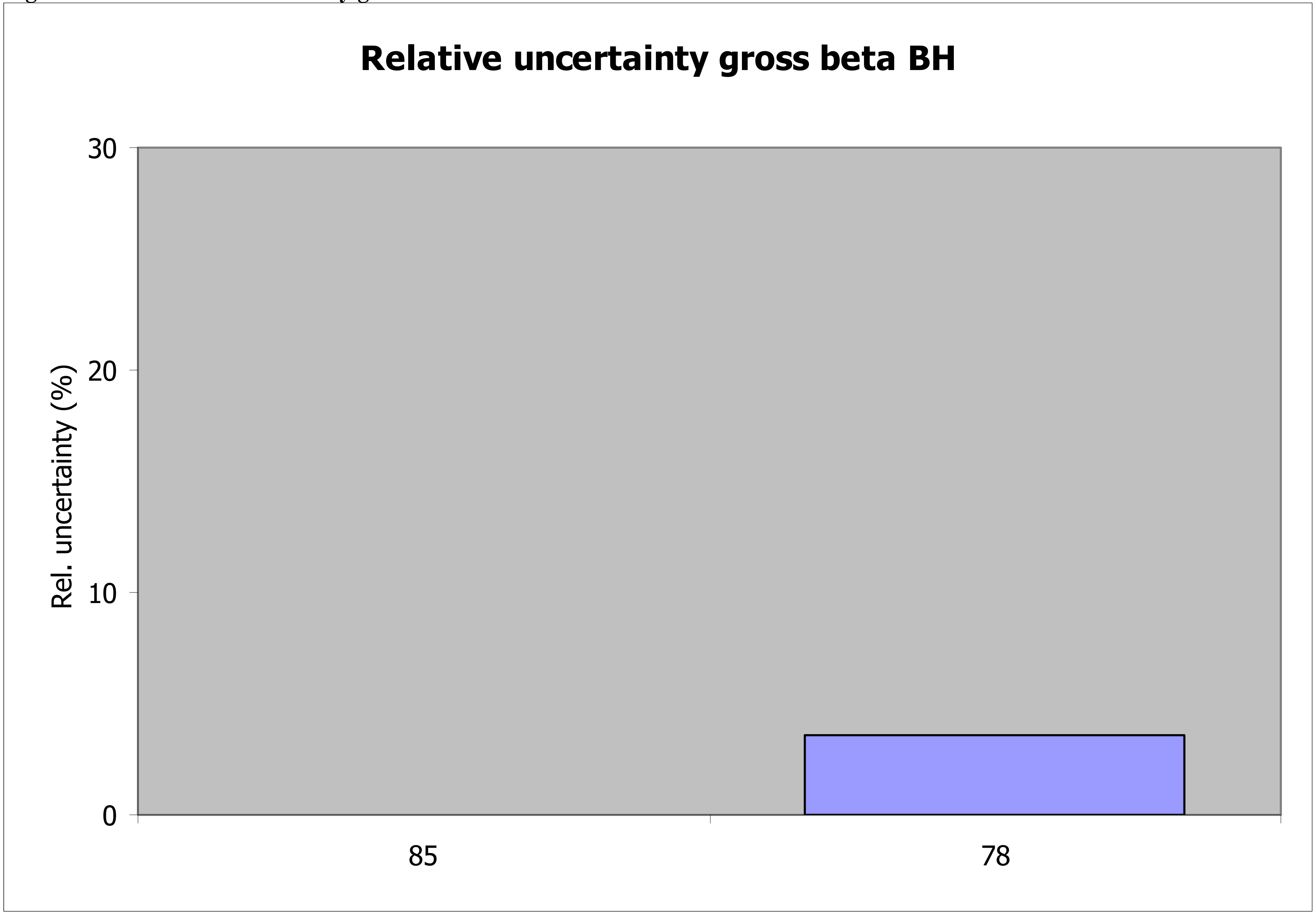


Figure 30D – Kiri plot gross beta BH

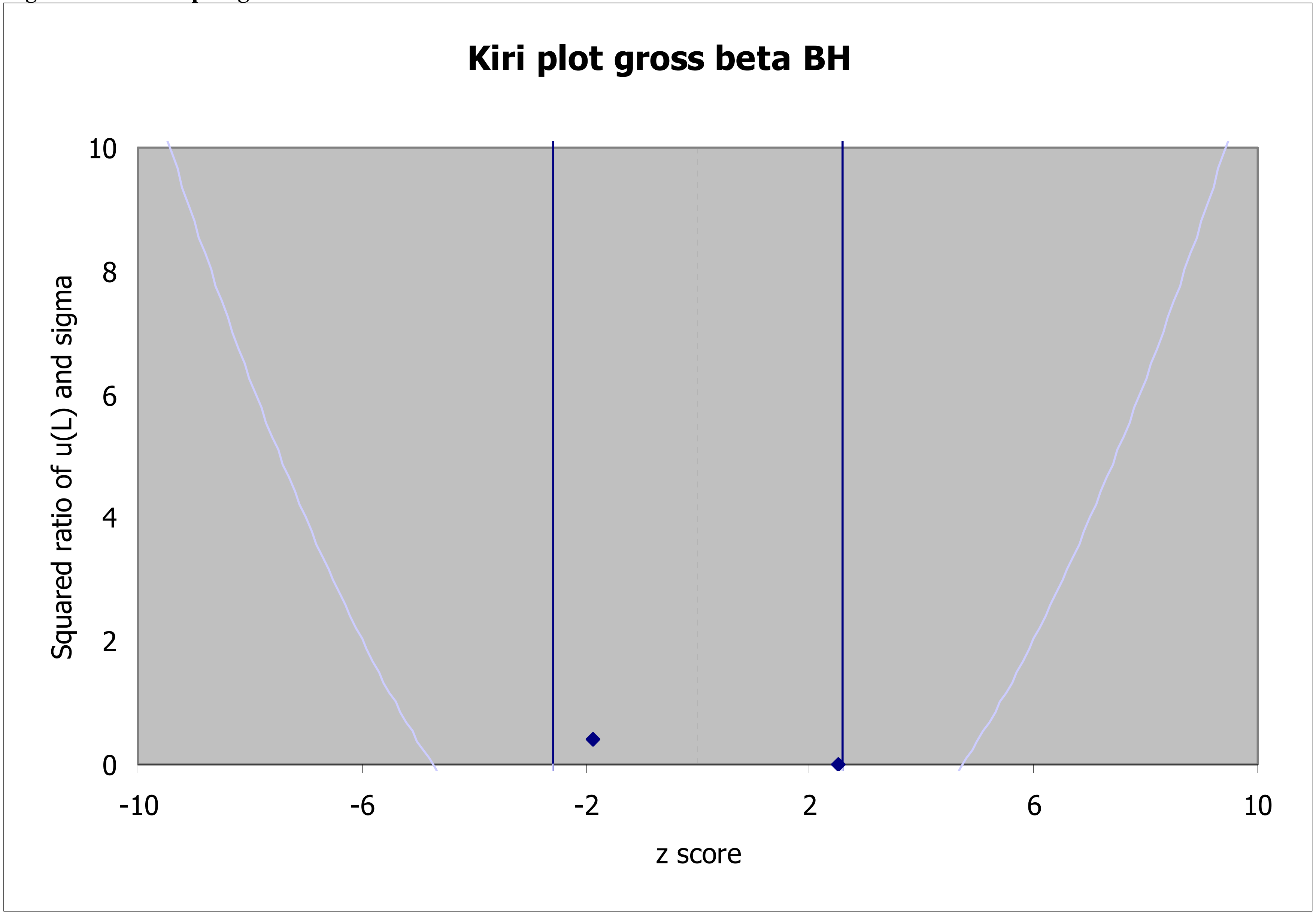


Figure 31A – Deviation H-3 HTO B2

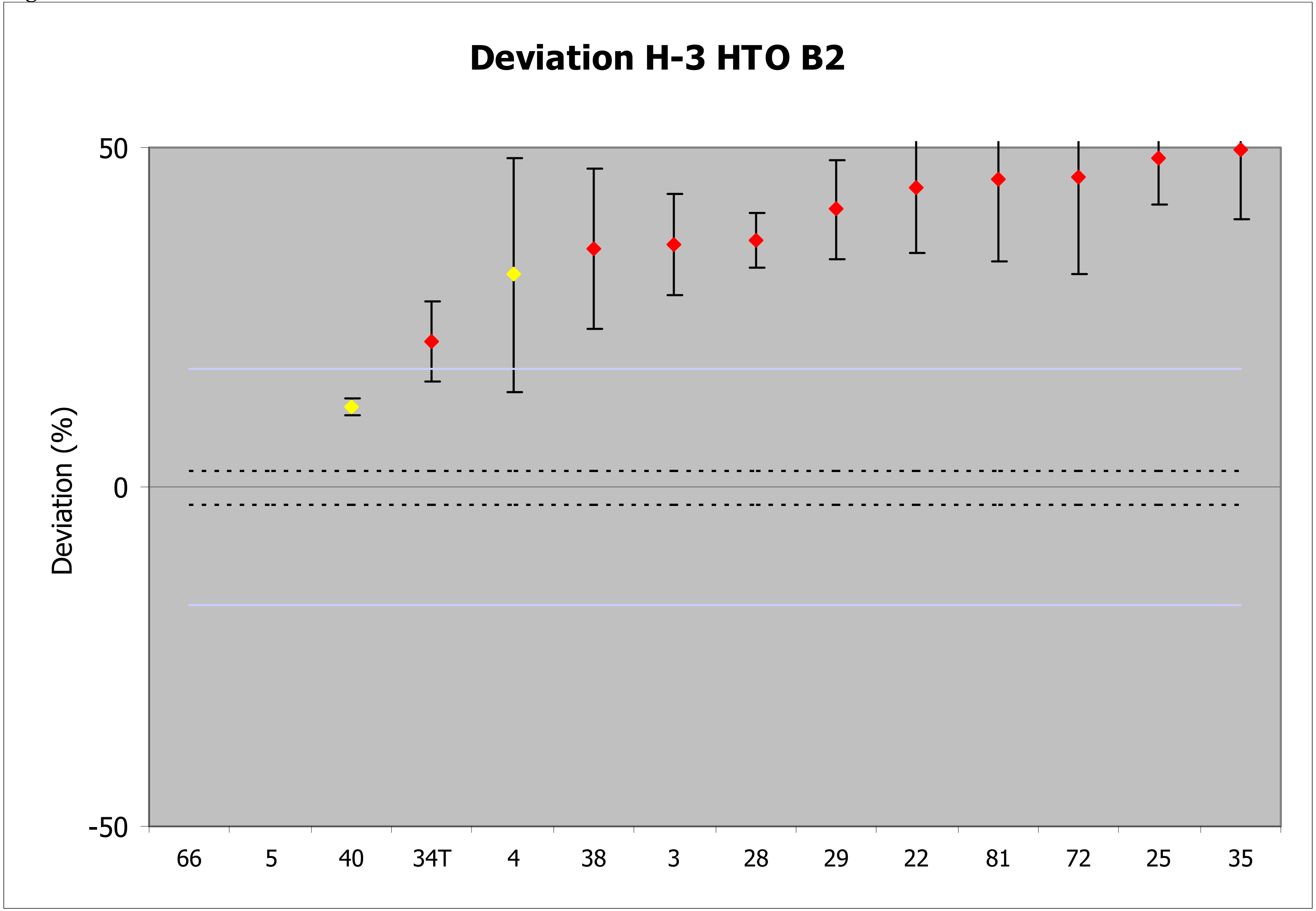


Figure 31B – Zeta score H-3 HTO B2

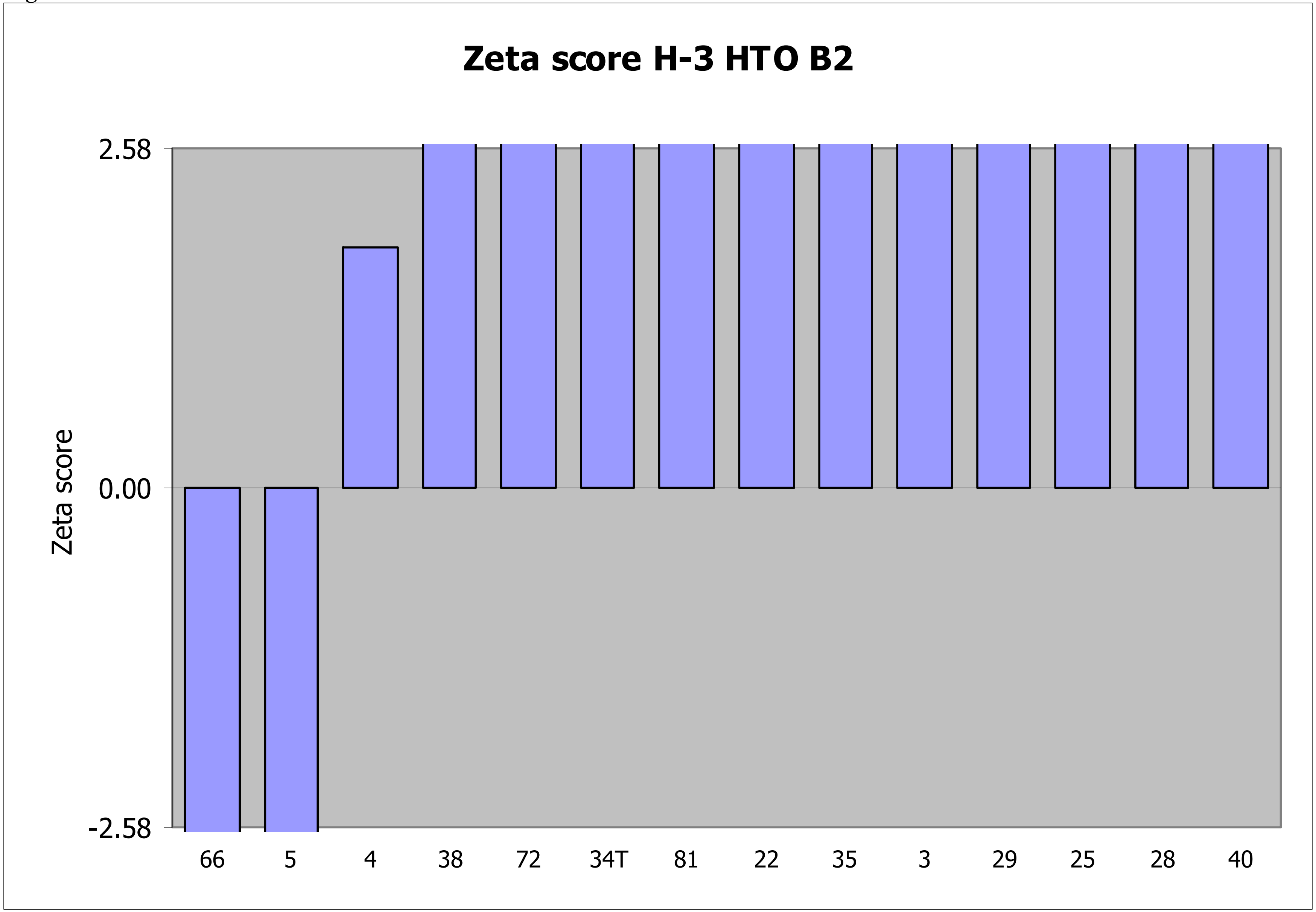


Figure 31C – Relative uncertainty H-3 HTO B2

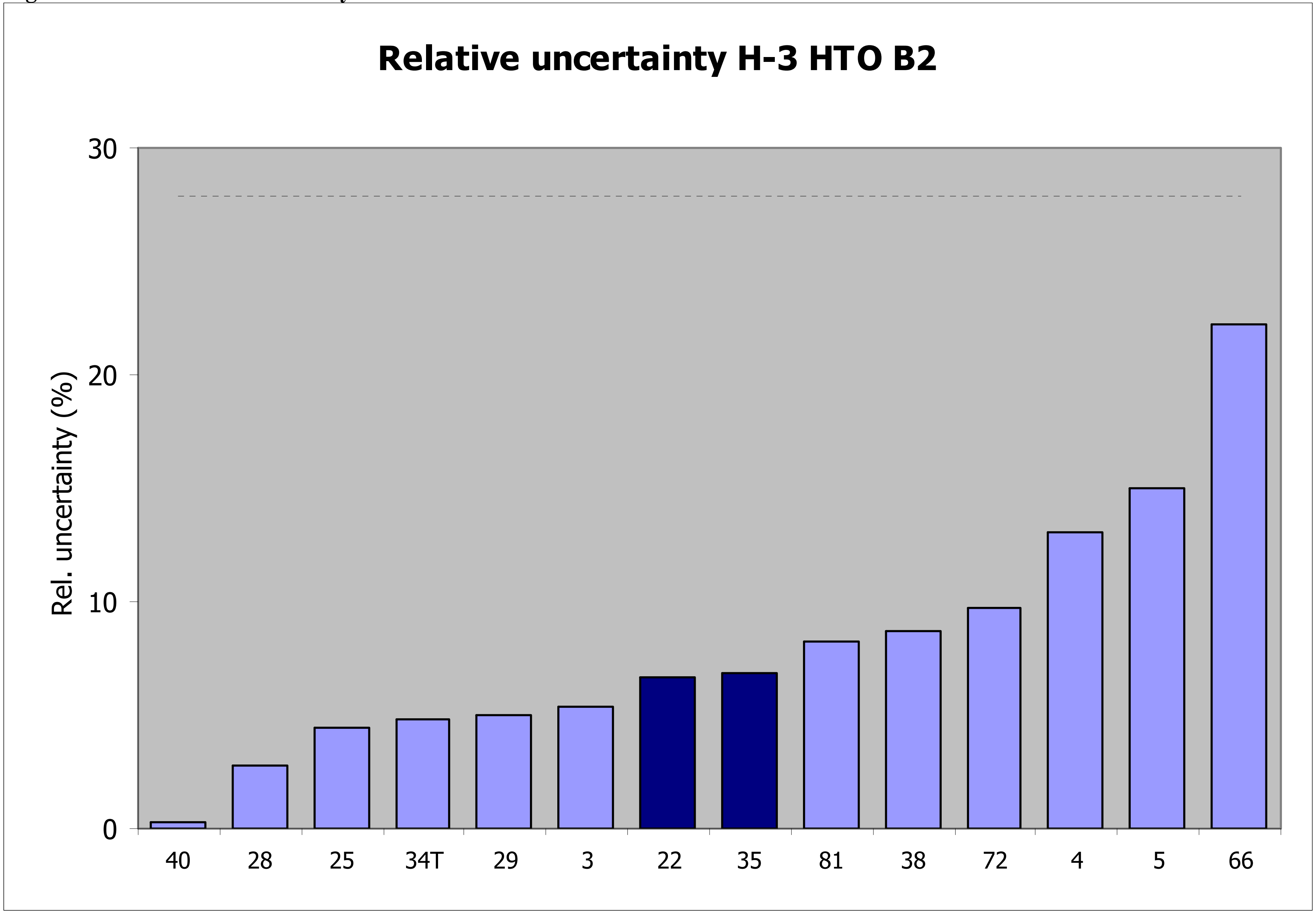


Figure 31D – Kiri plot H-3 HTO B2

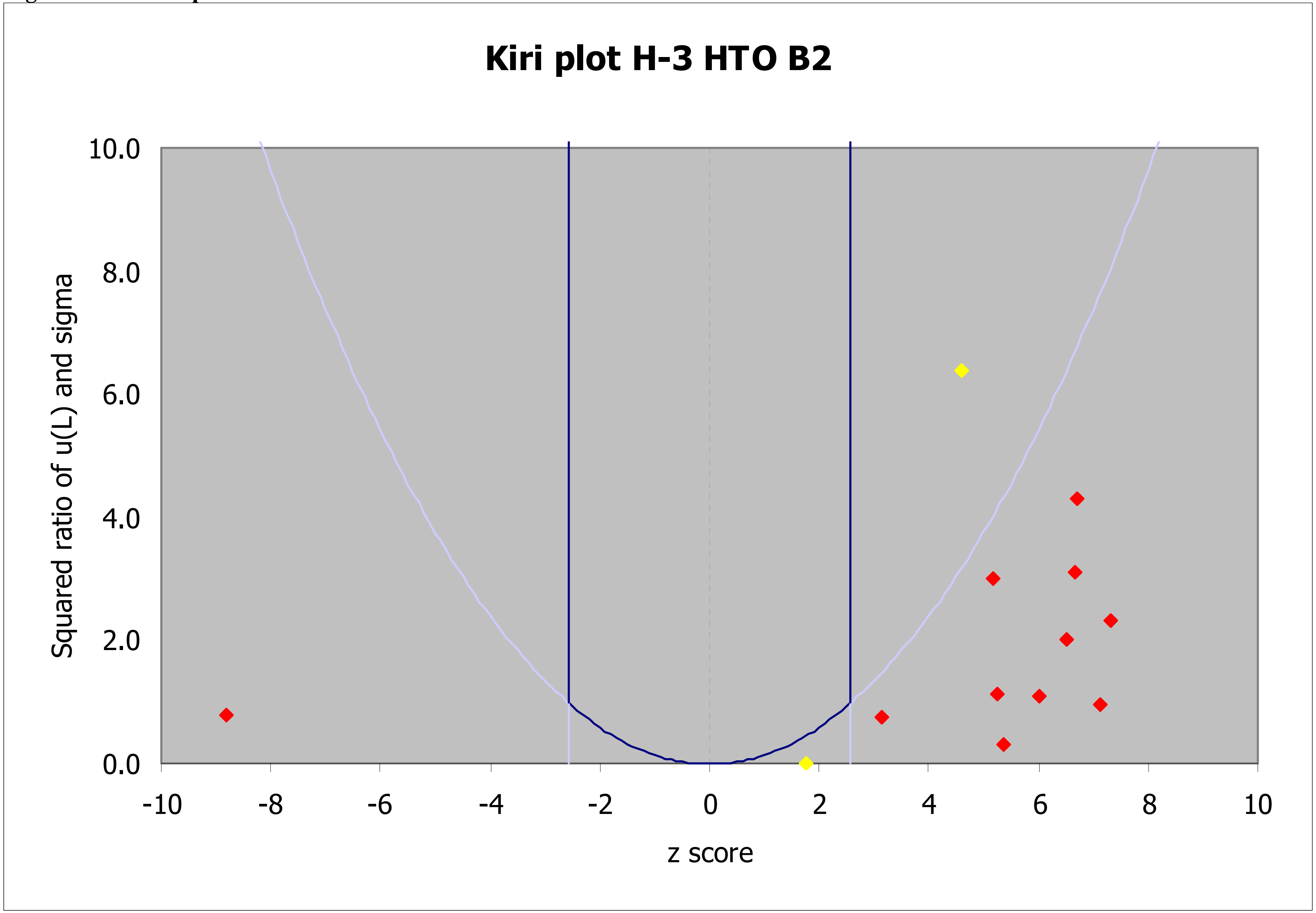


Figure 31A* – Deviation H-3 B2

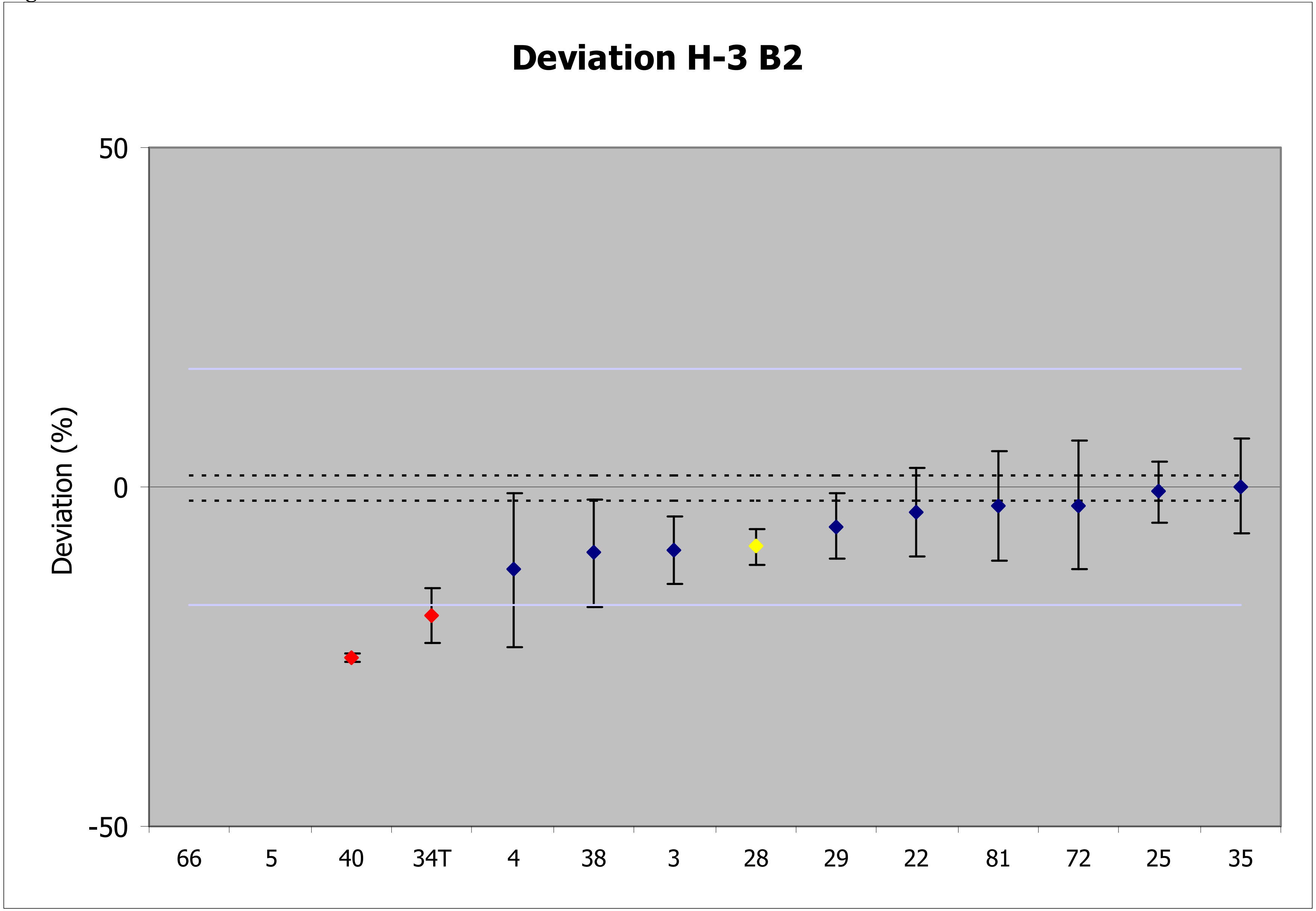


Figure 31B* – Zeta score H-3 B2

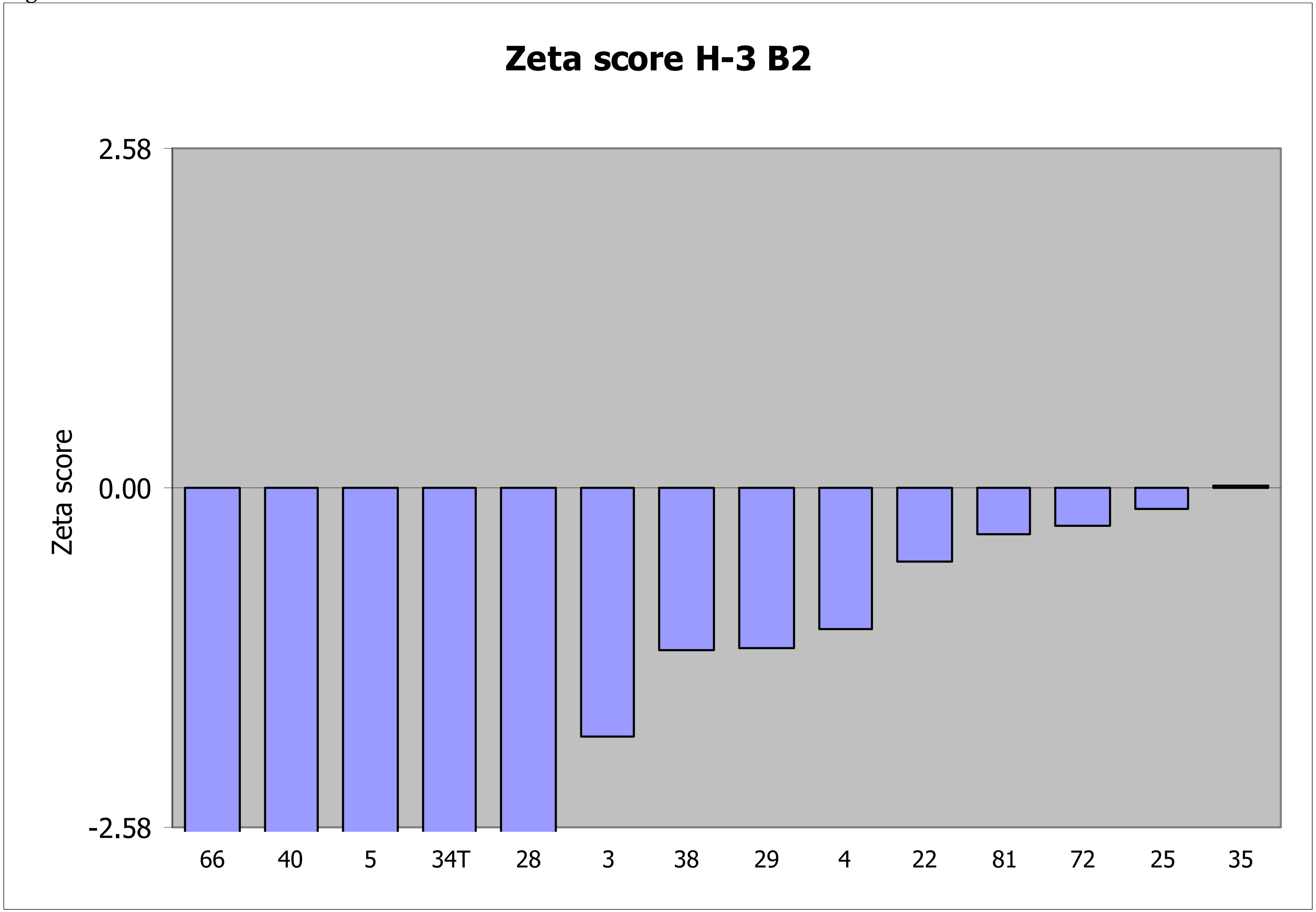


Figure 31C* – Relative uncertainty H-3 B2

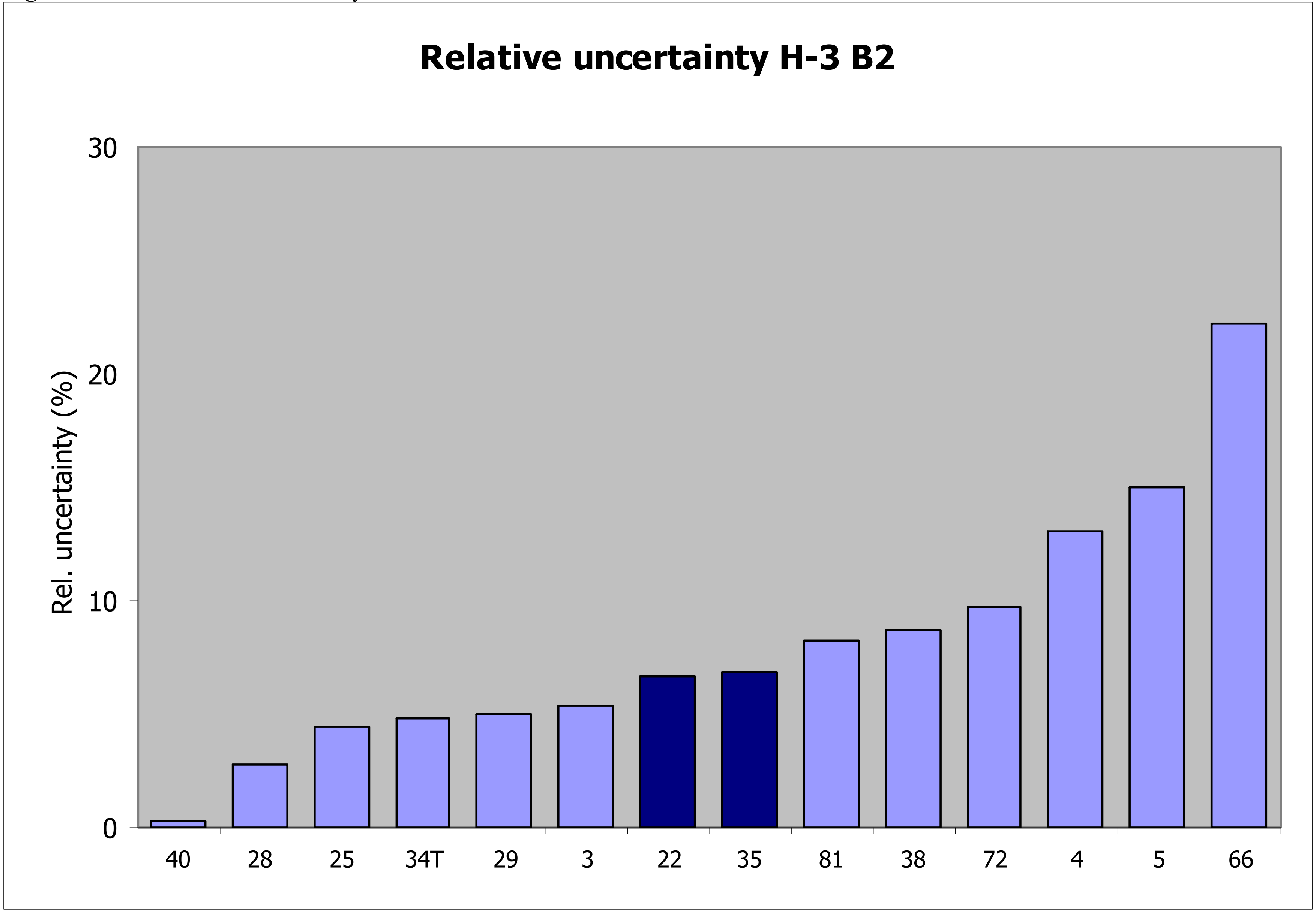


Figure 31D* – Kiri plot H-3 B2

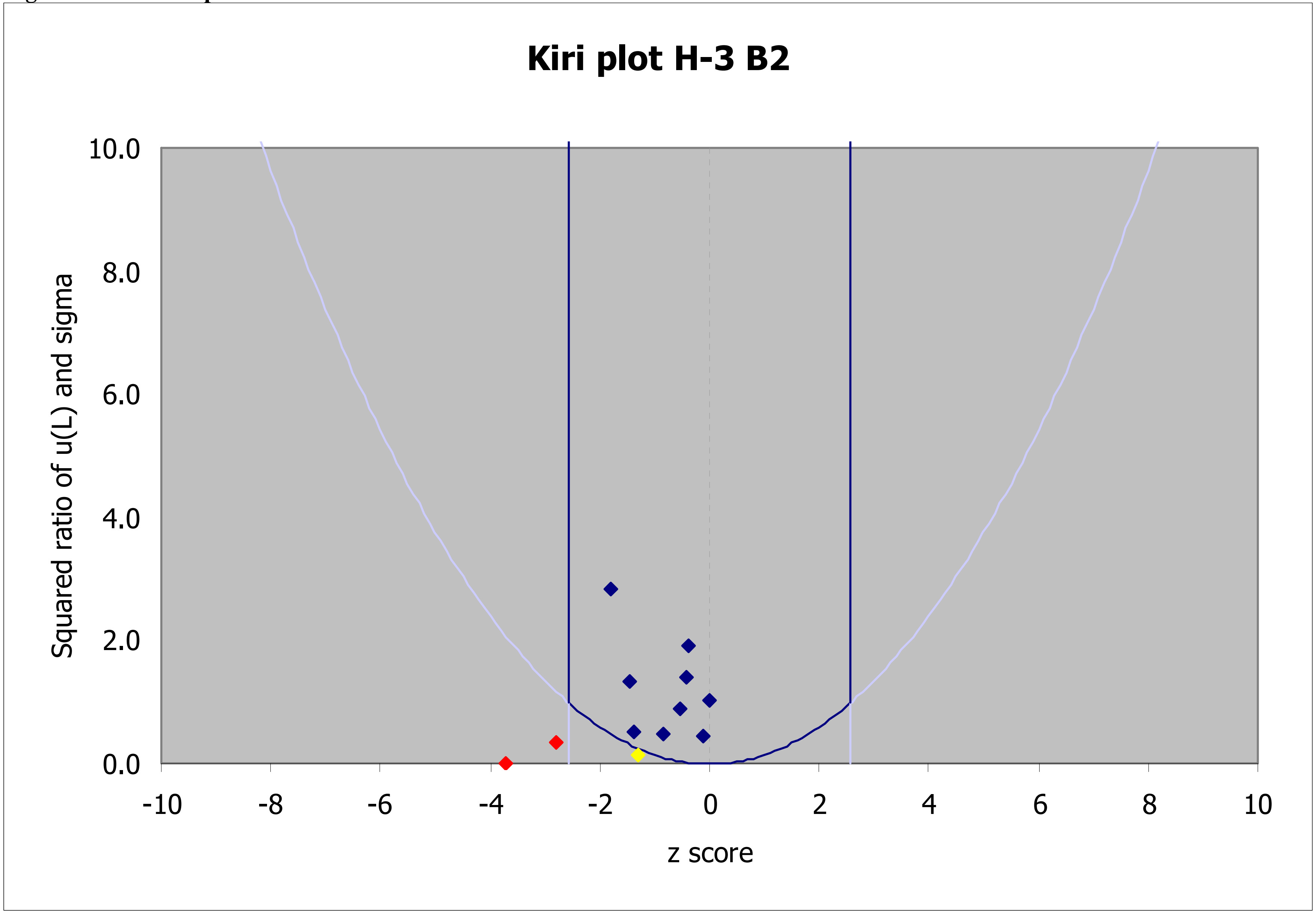


Figure 32A – Deviation H-3 OBT B2

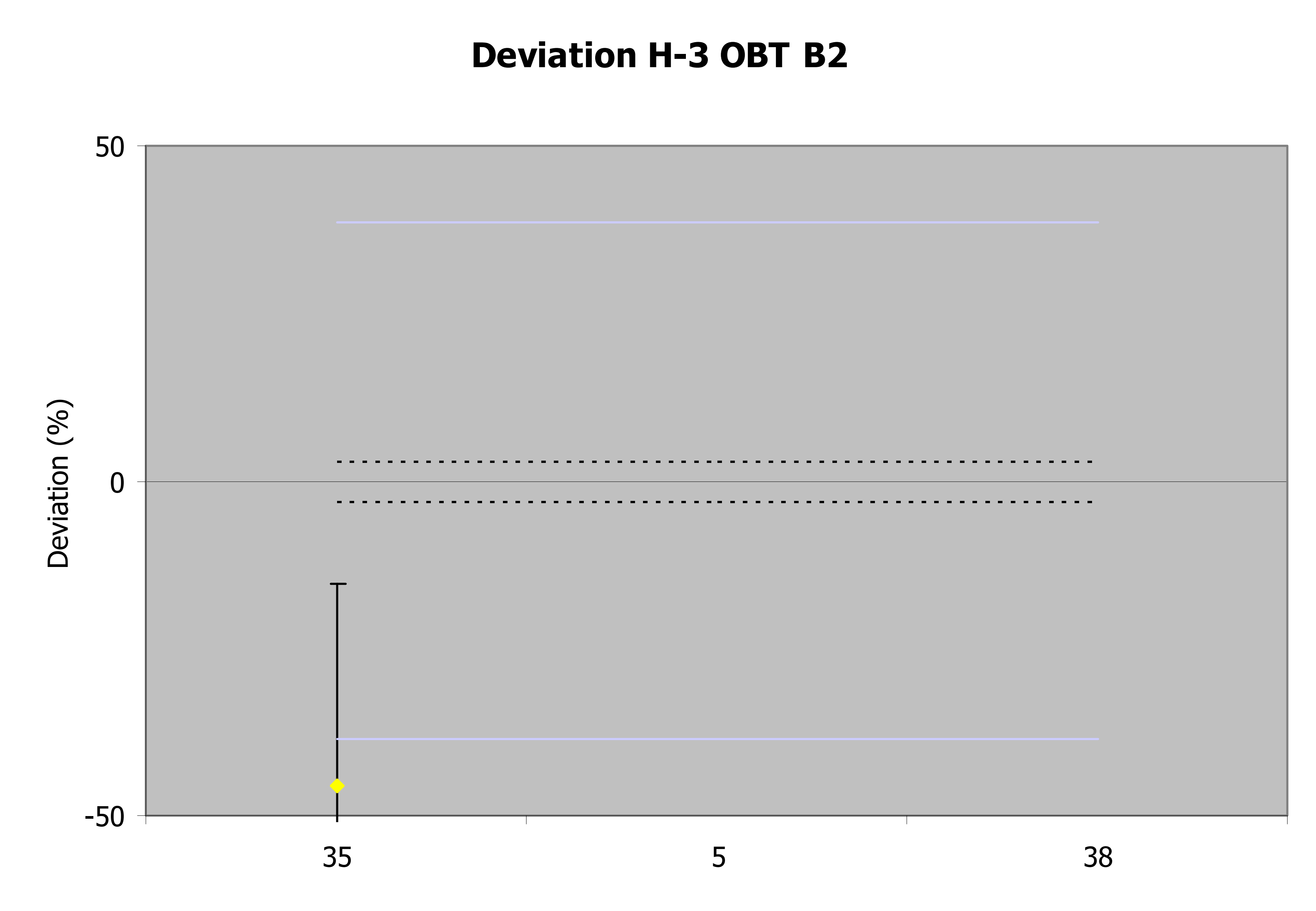


Figure 32B – Zeta score H-3 OBT B2

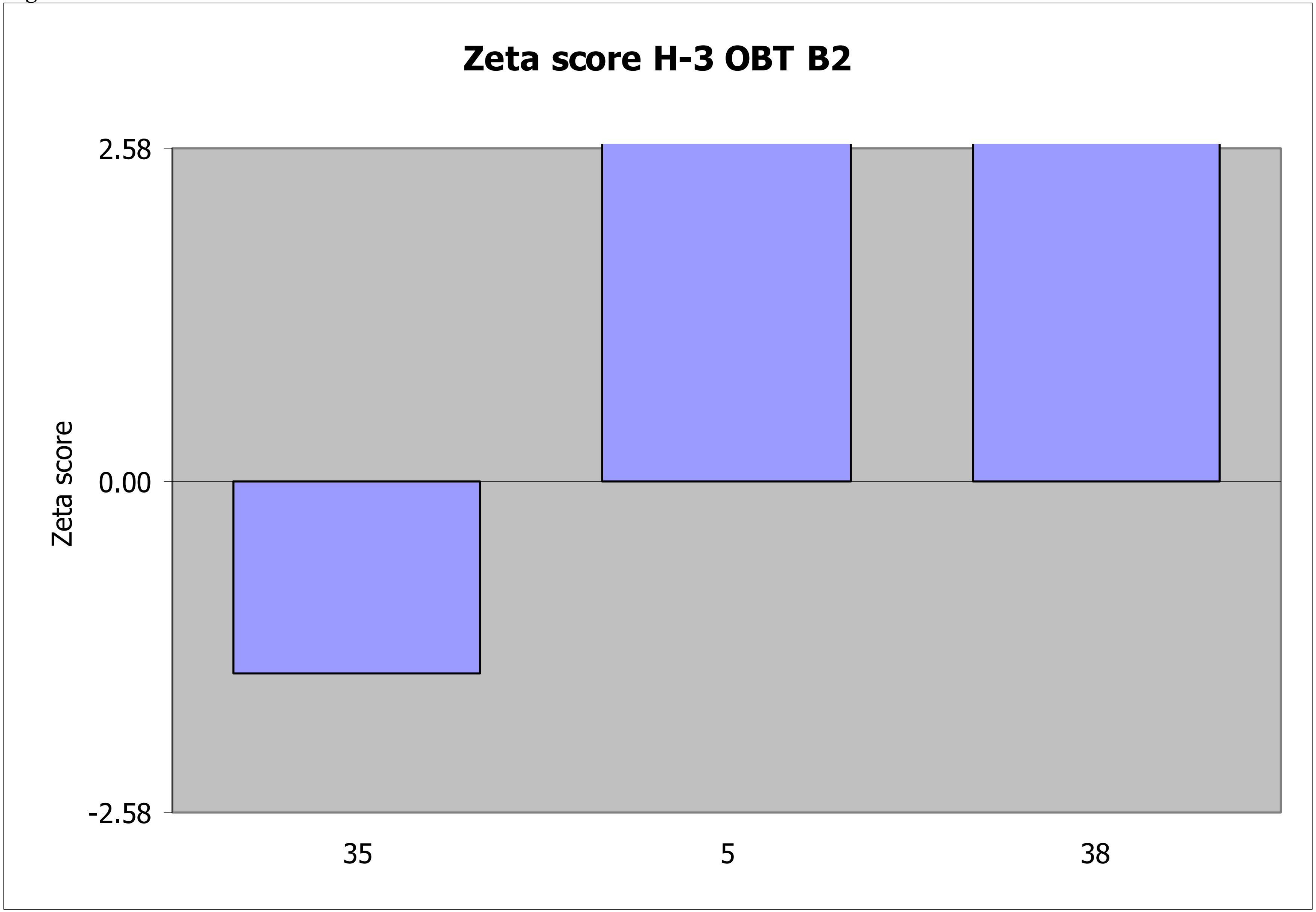


Figure 32C – Relative uncertainty H-3 OBT B2

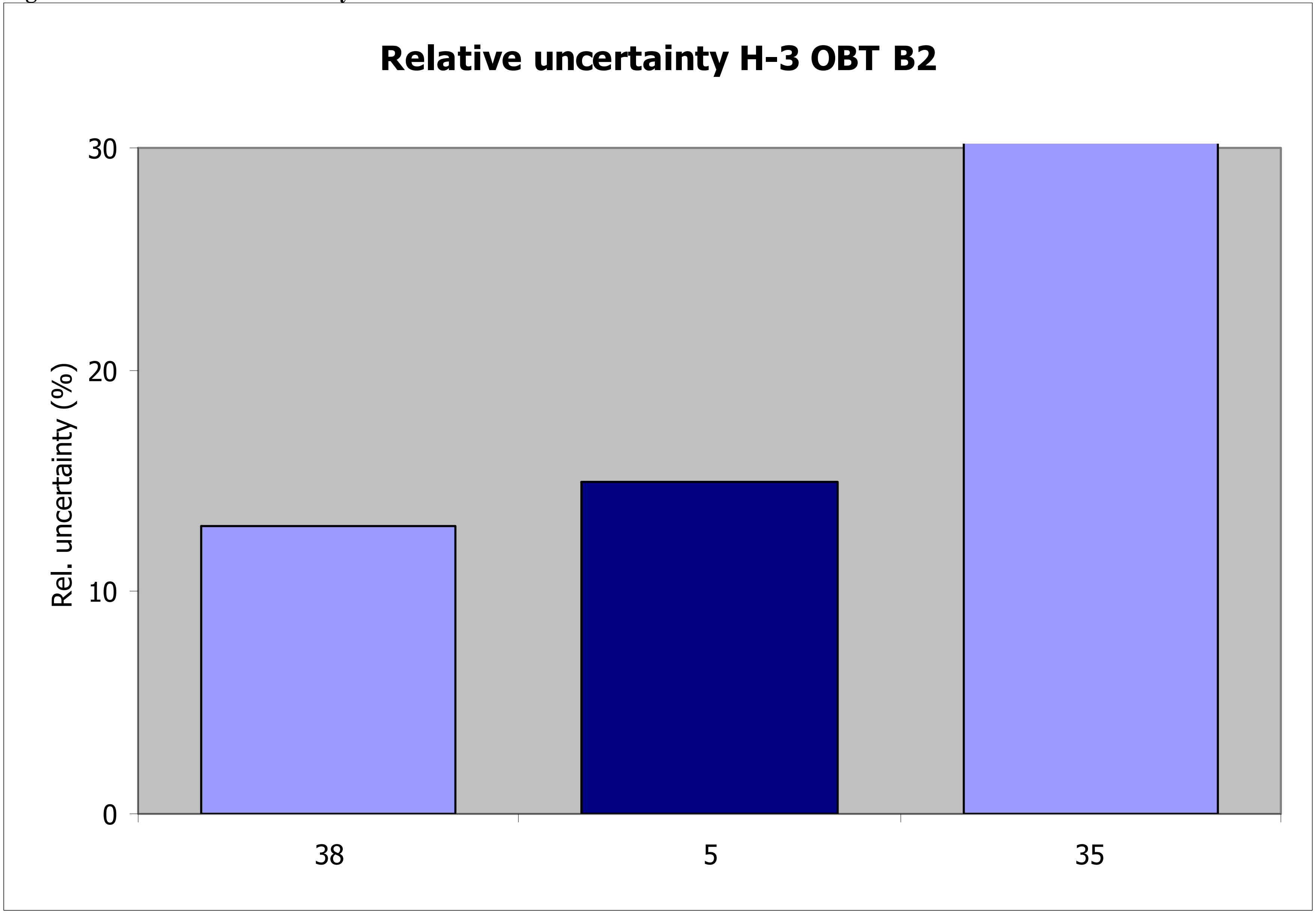


Figure 32D – Kiri plot H-3 OBT B2

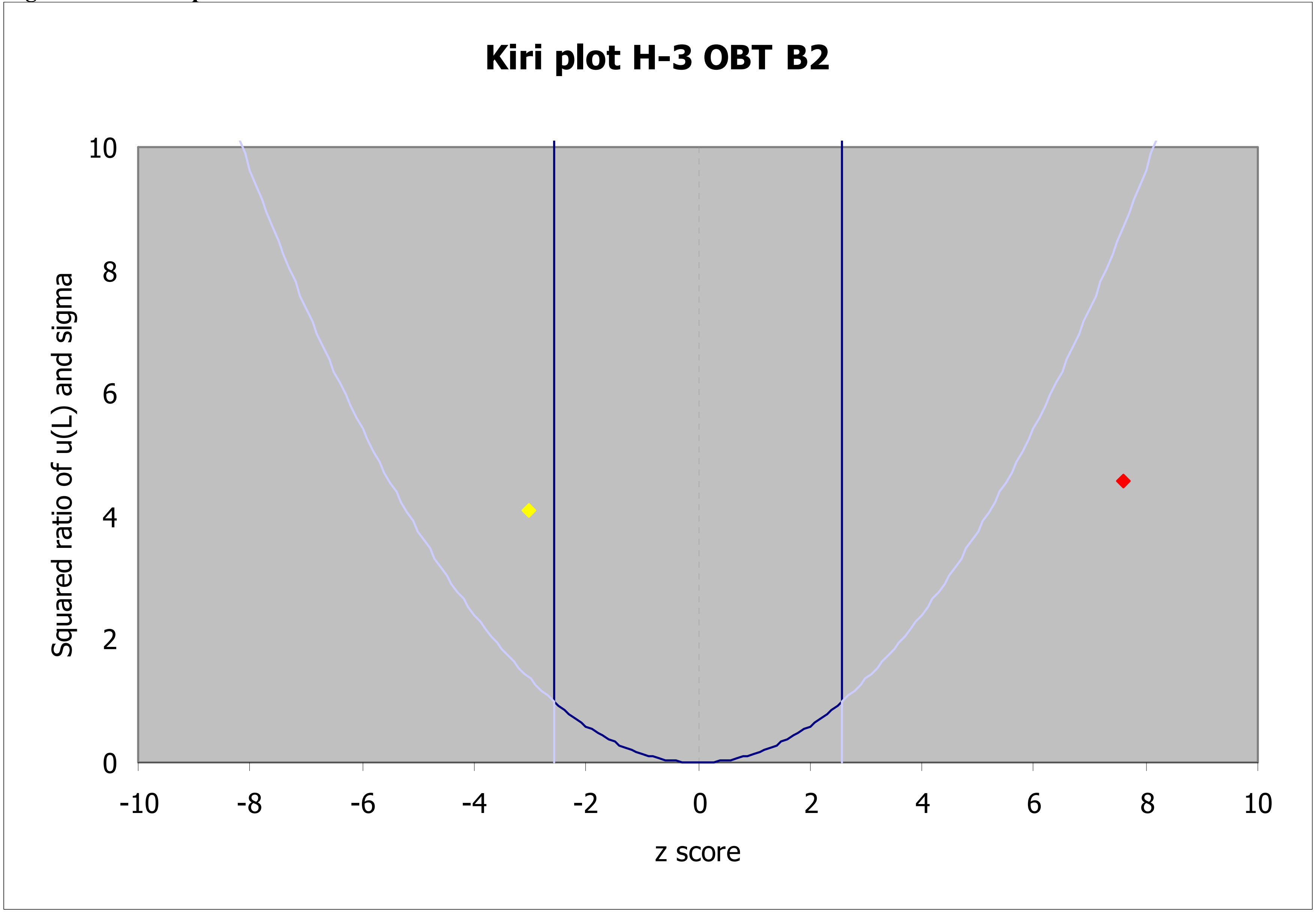


Figure 33A – Deviation C-14 B2

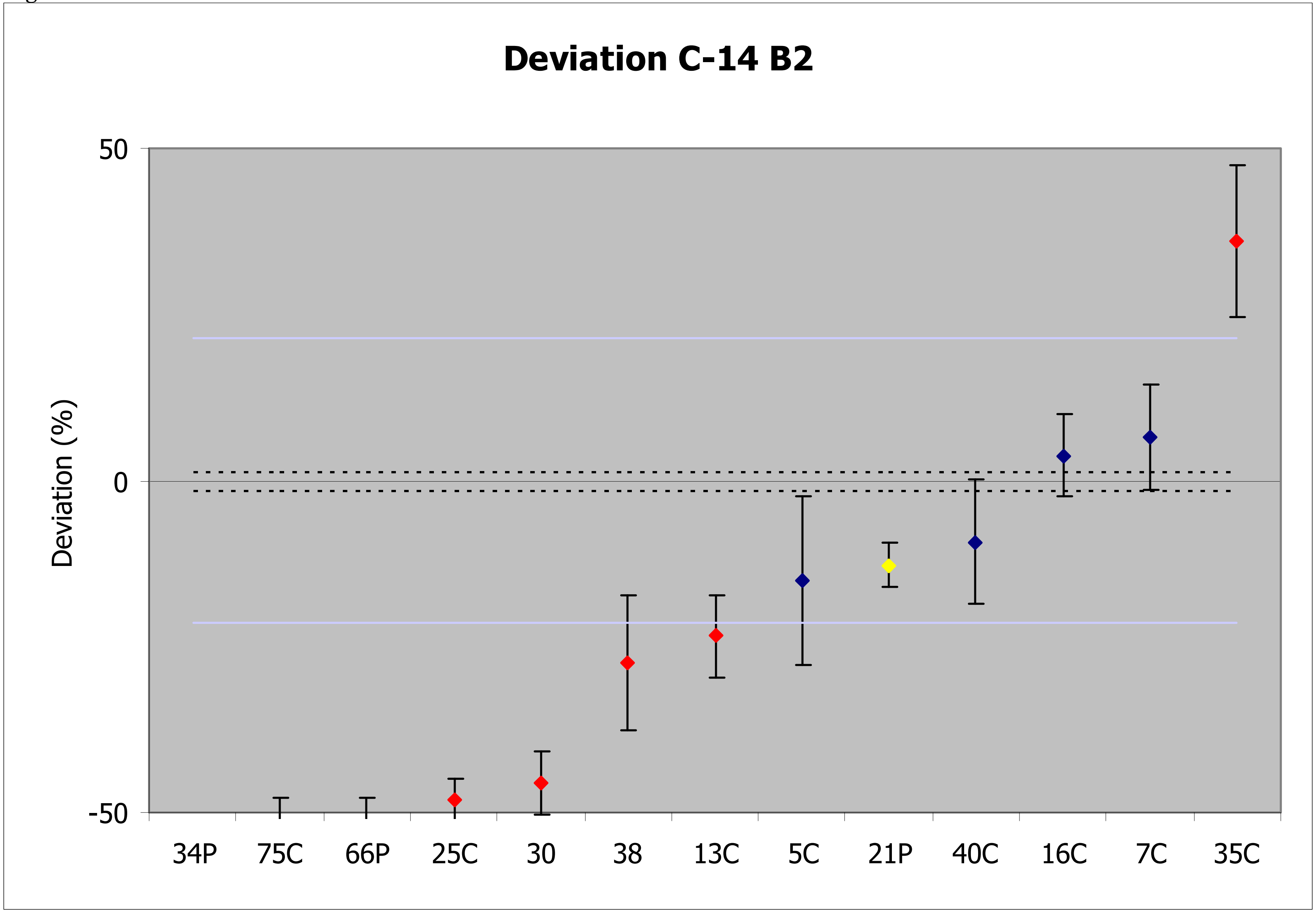


Figure 33B – Zeta score C-14 B2

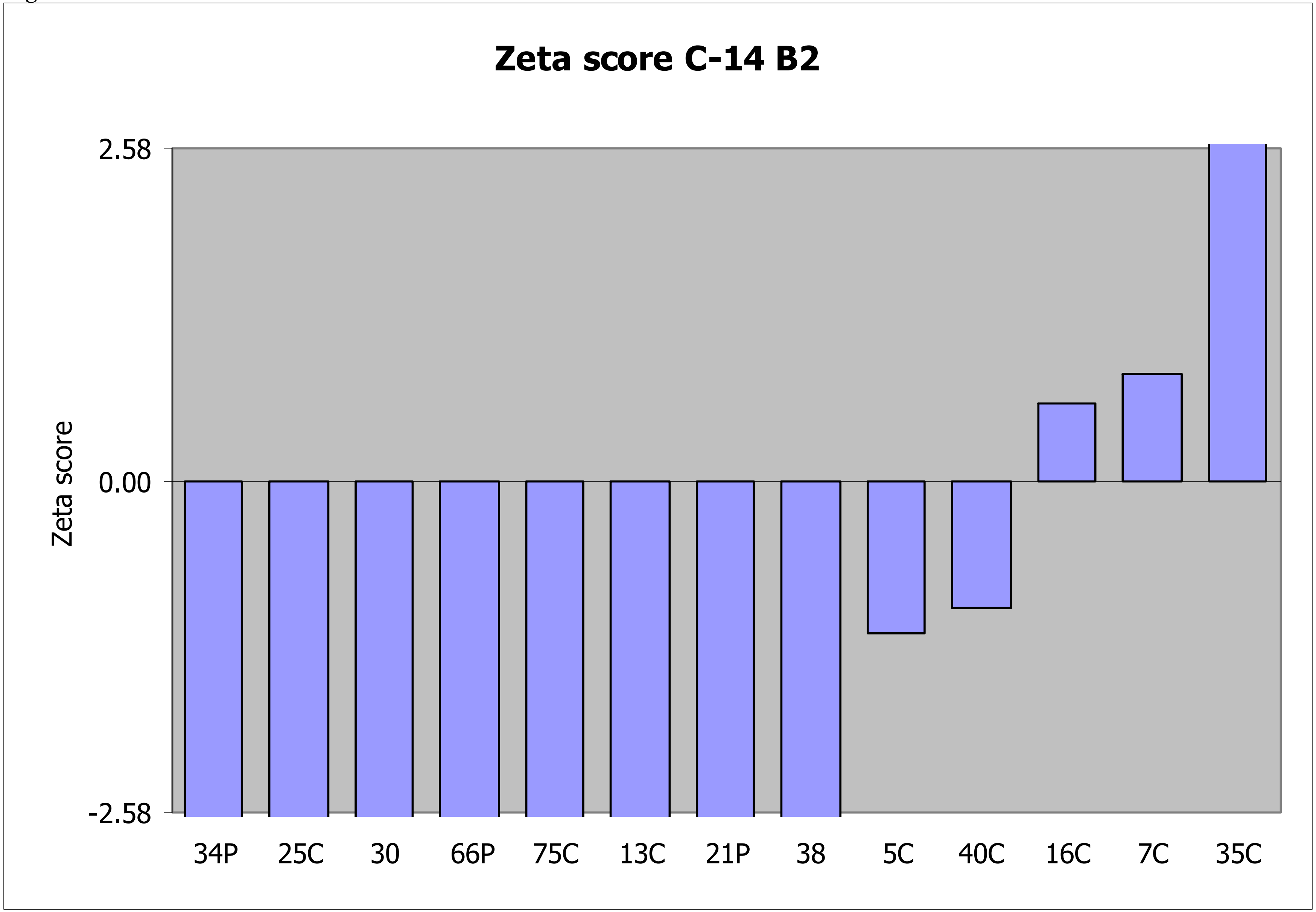


Figure 33C – Relative uncertainty C-14 B2

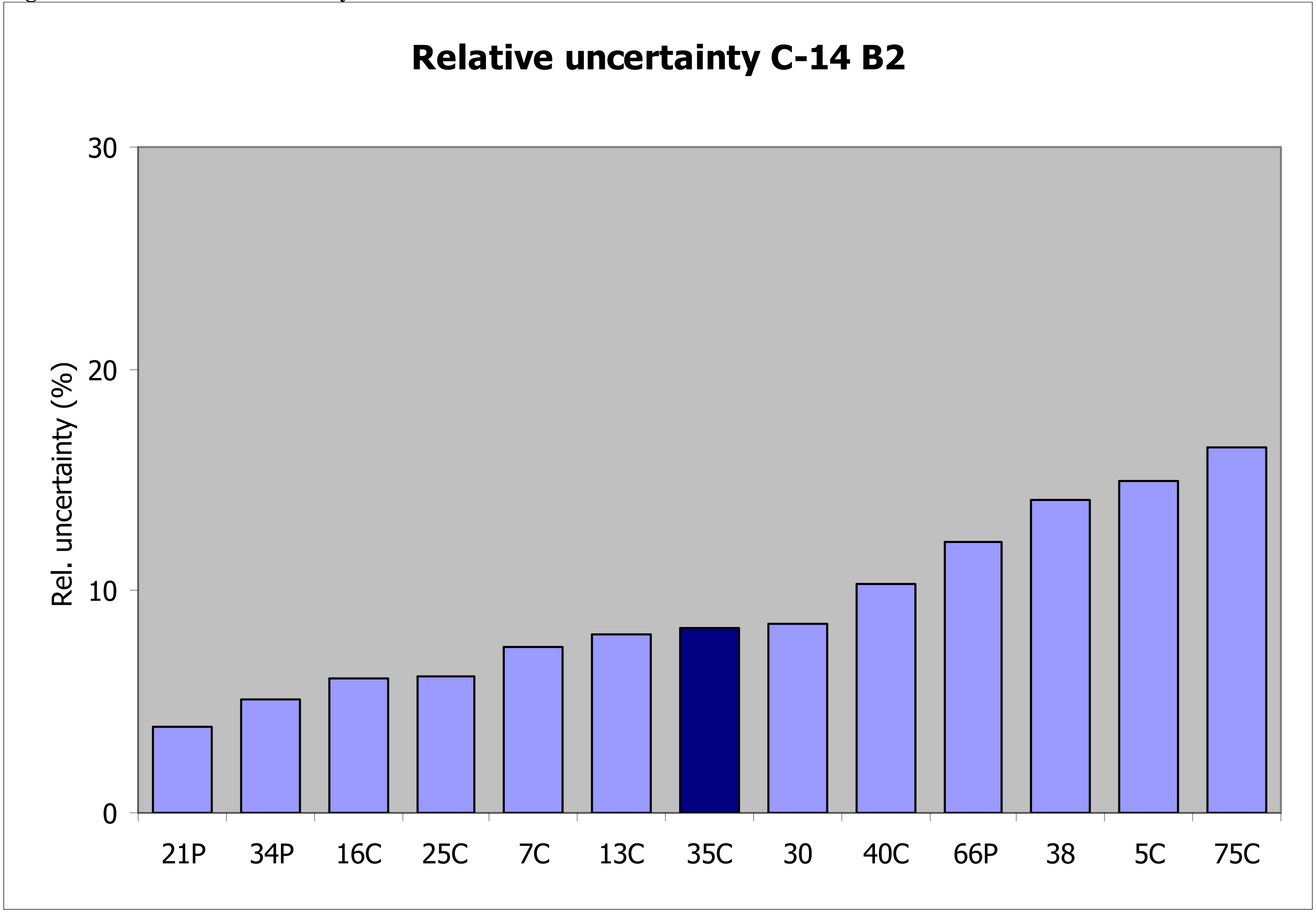


Figure 33D – Kiri plot C-14 B2

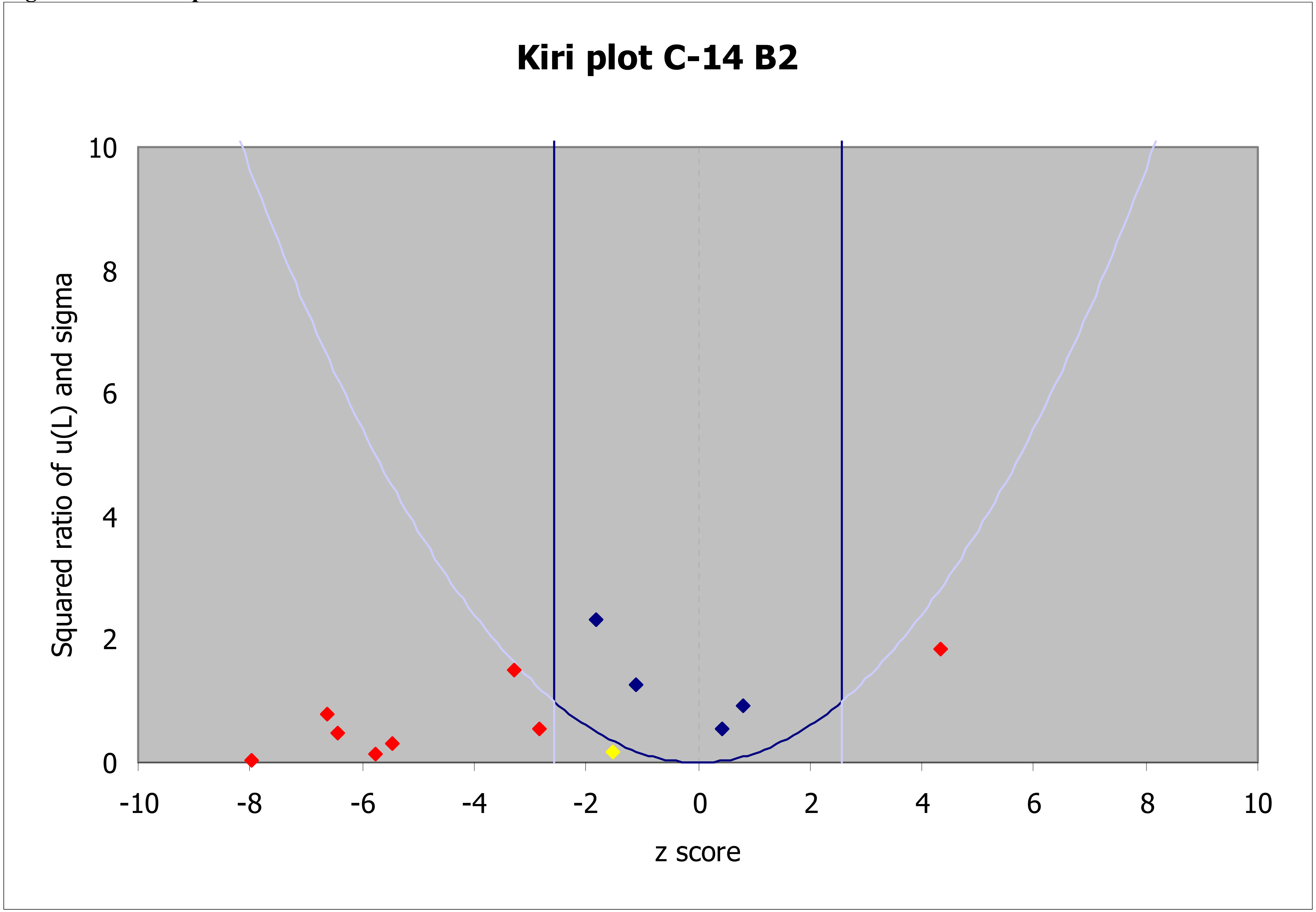


Figure 34A – Deviation Cl-36 B2

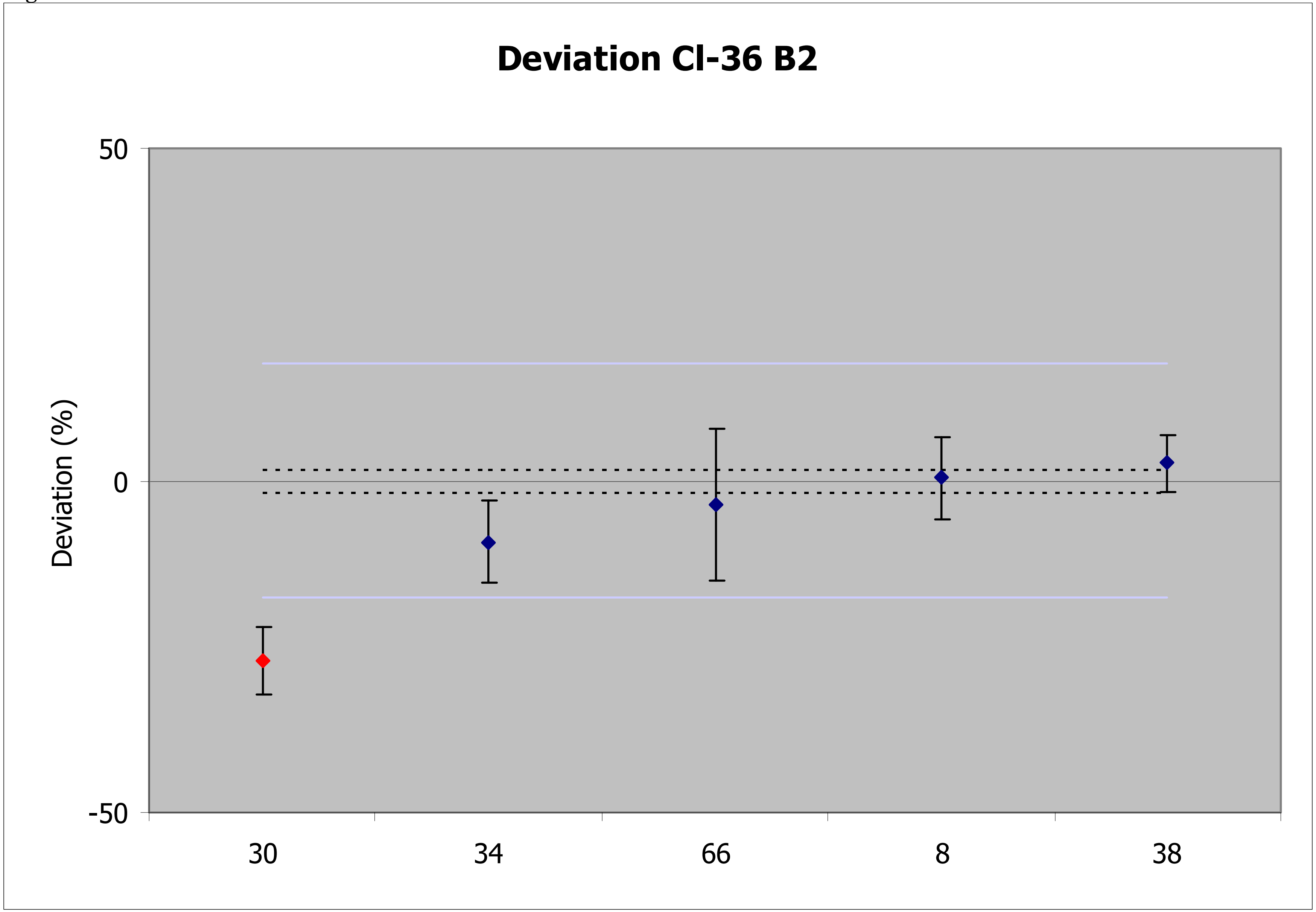


Figure 34B – Zeta score Cl-36 B2

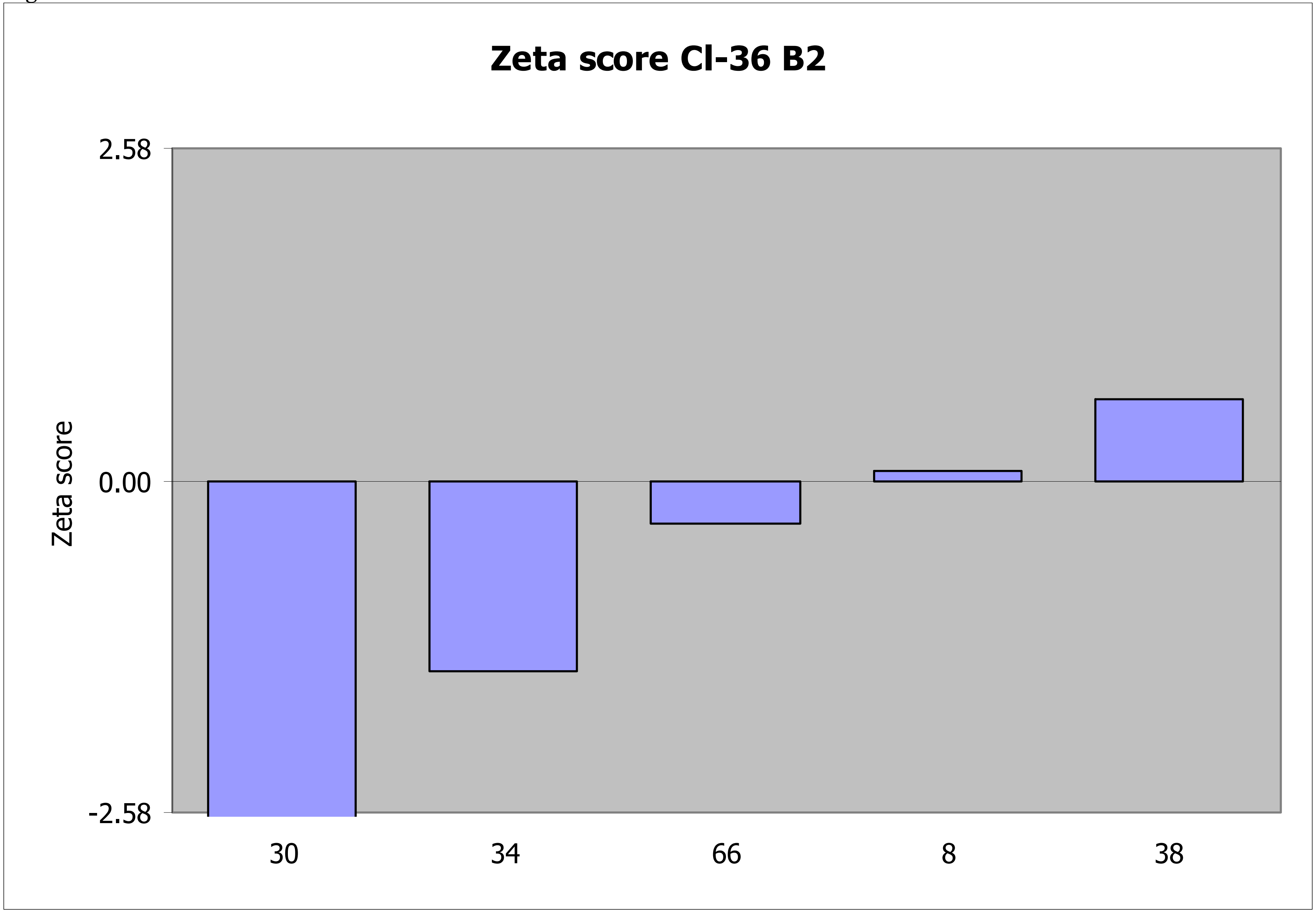


Figure 34C – Relative uncertainty Cl-36 B2

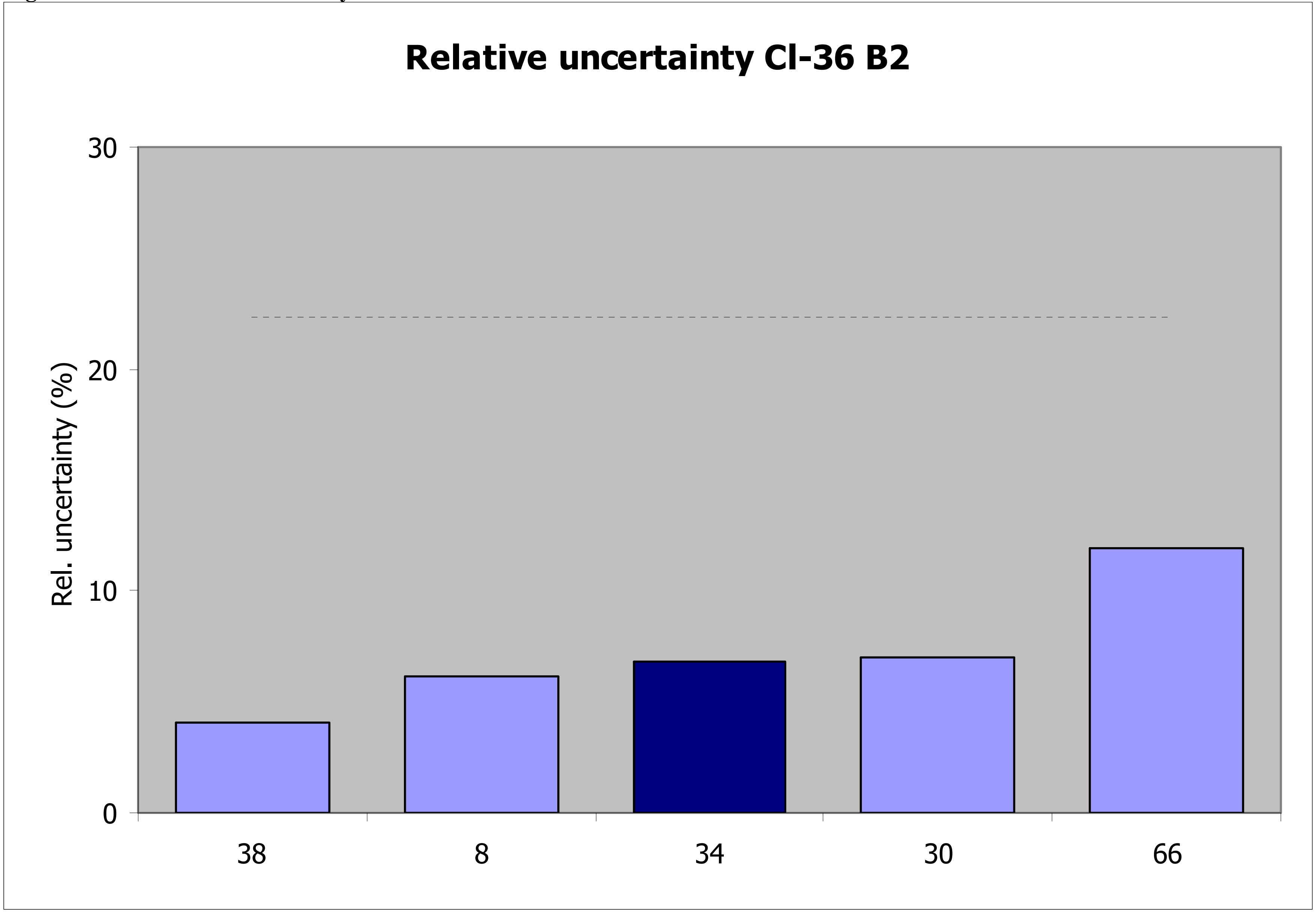


Figure 34D – Kiri plot Cl-36 B2

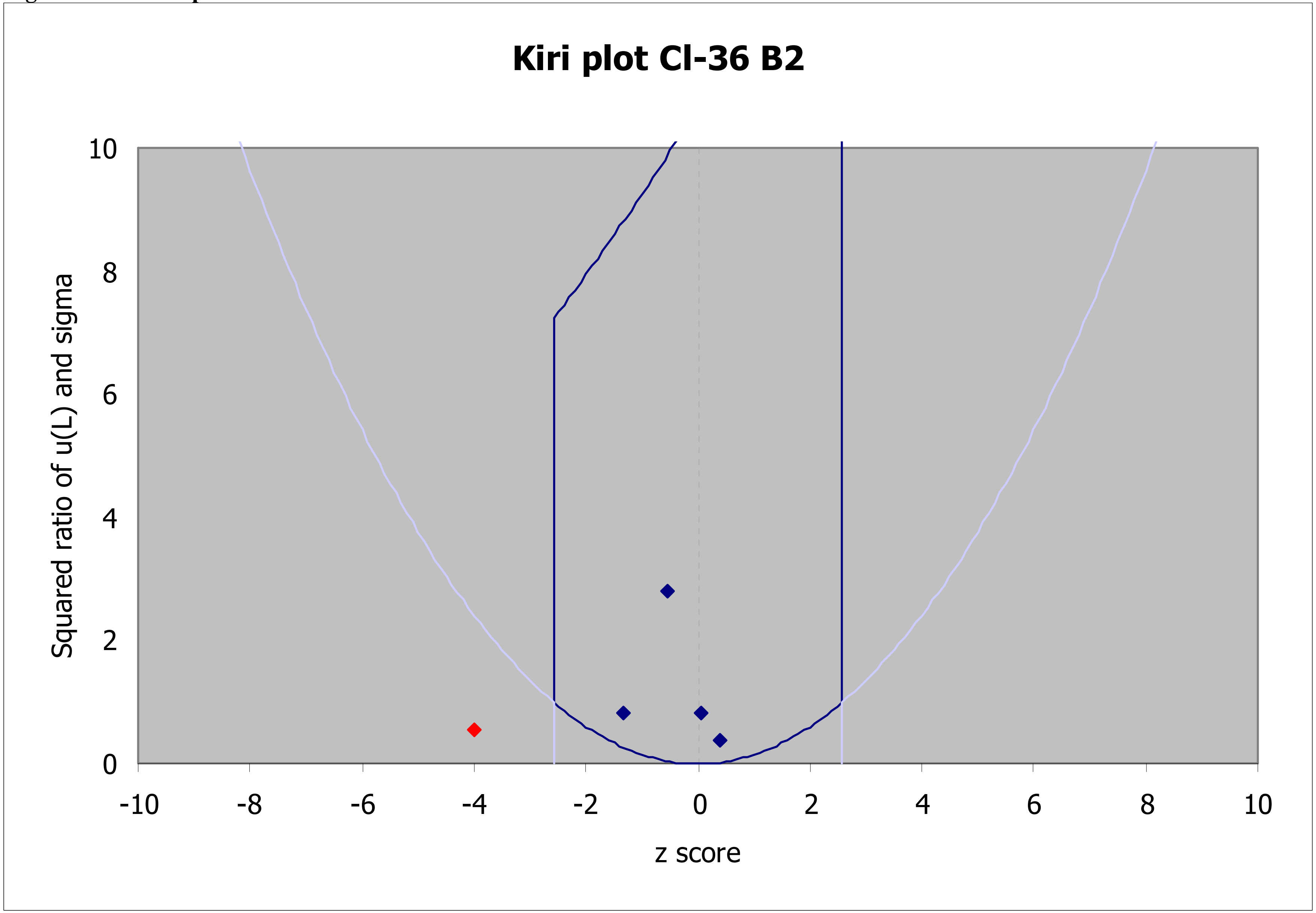


Figure 35A – Deviation I-129 B2

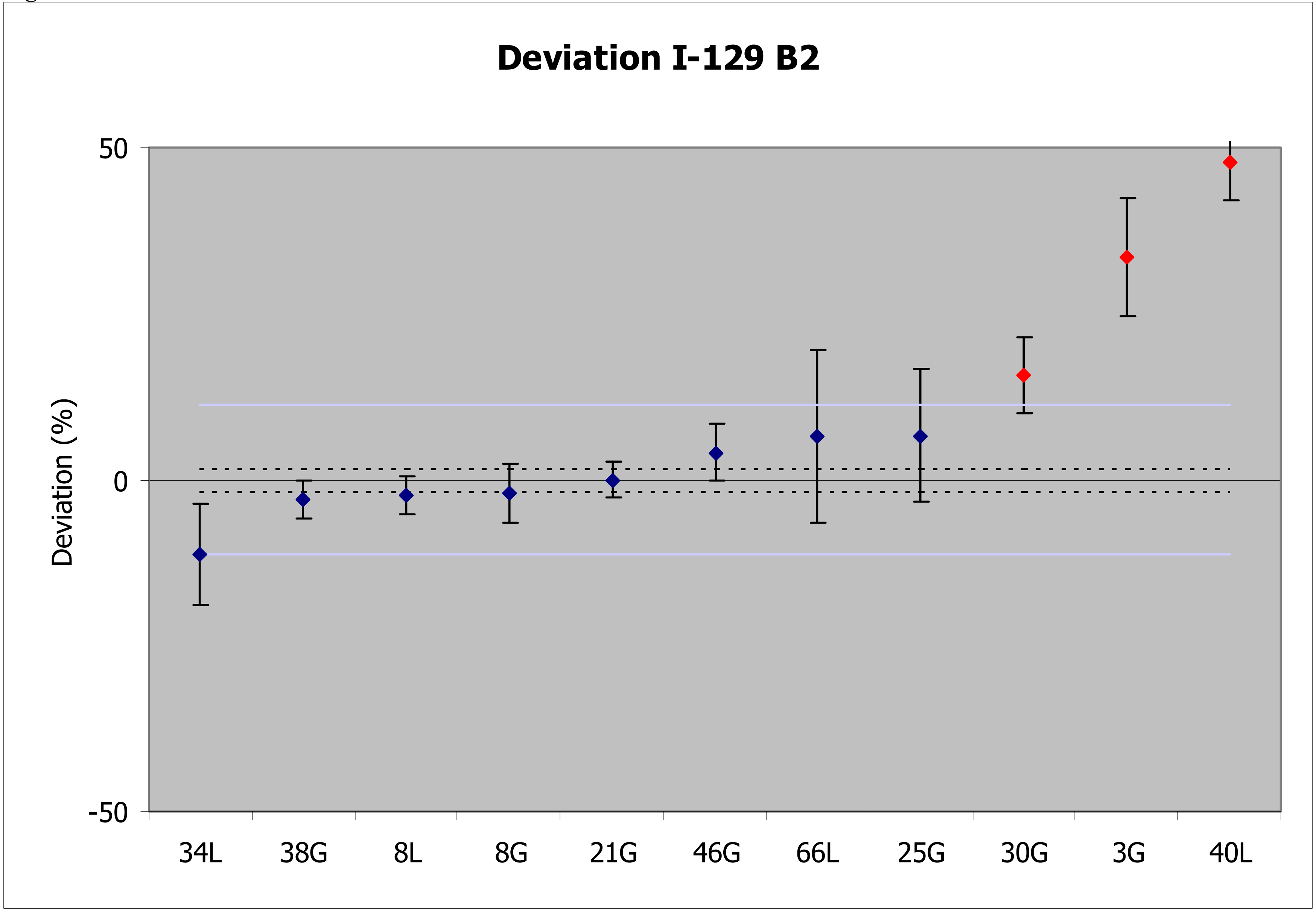


Figure 35B – Zeta score I-129 B2

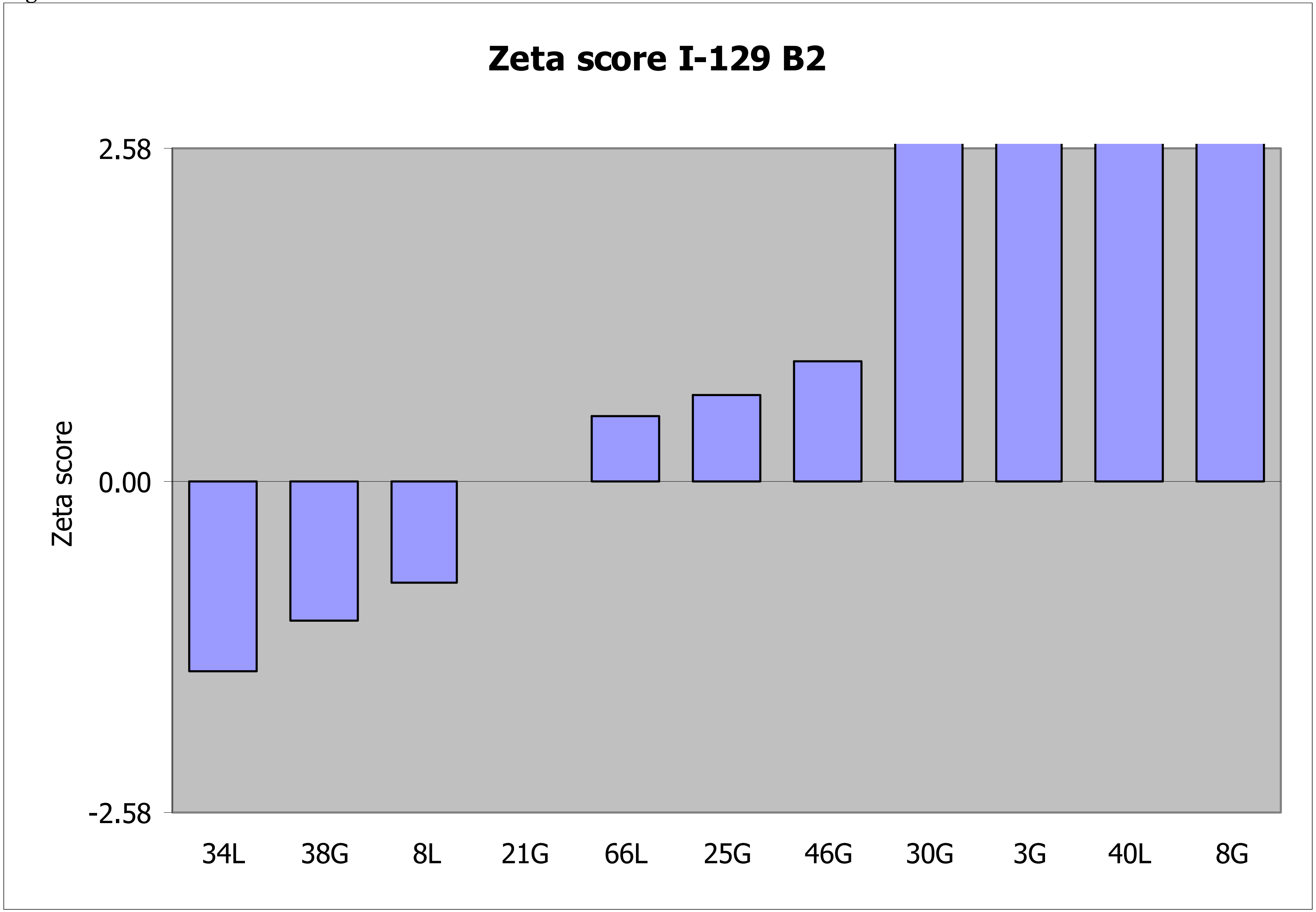


Figure 35C – Relative uncertainty I-129 B2

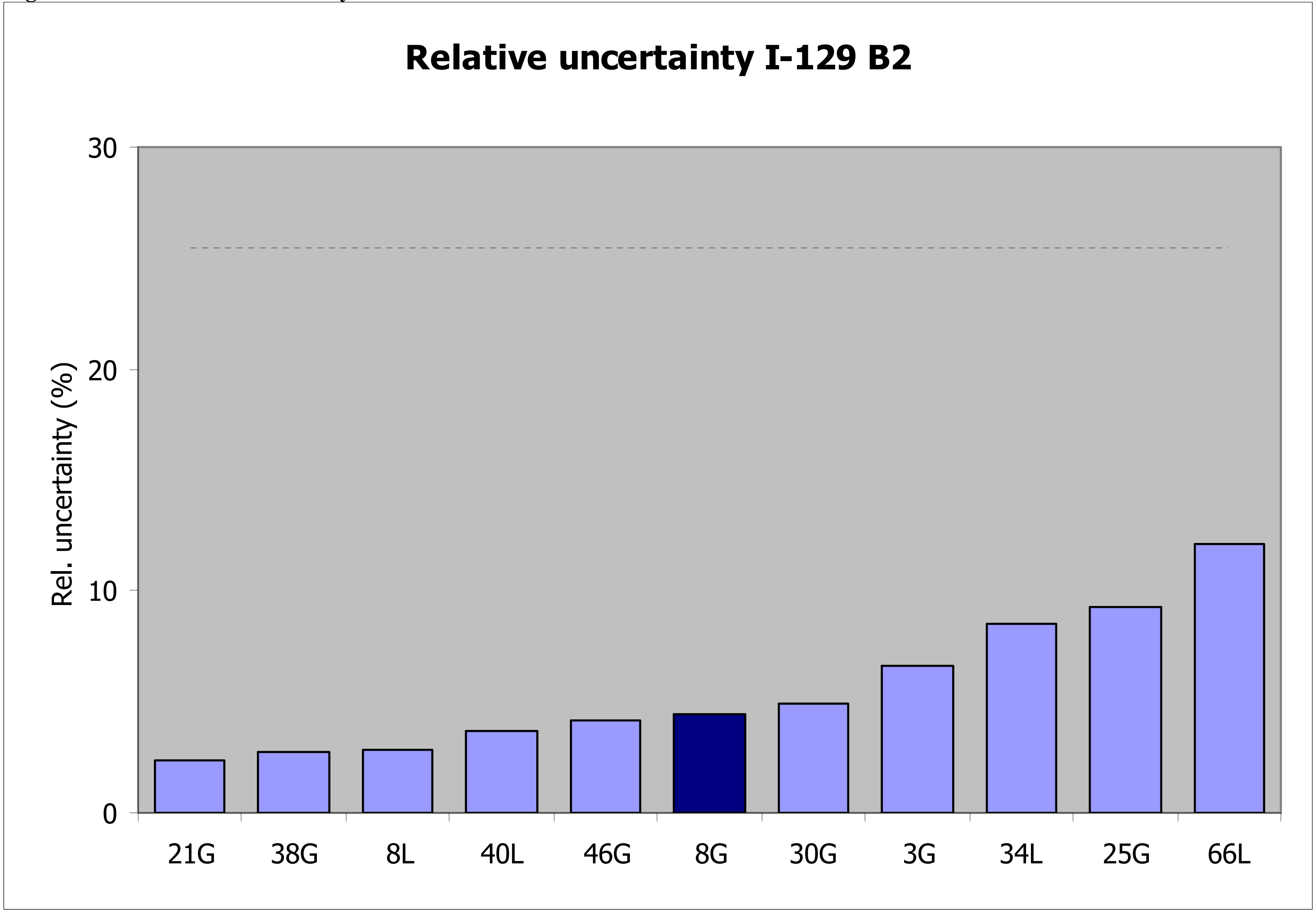


Figure 35D – Kiri plot I-129 B2

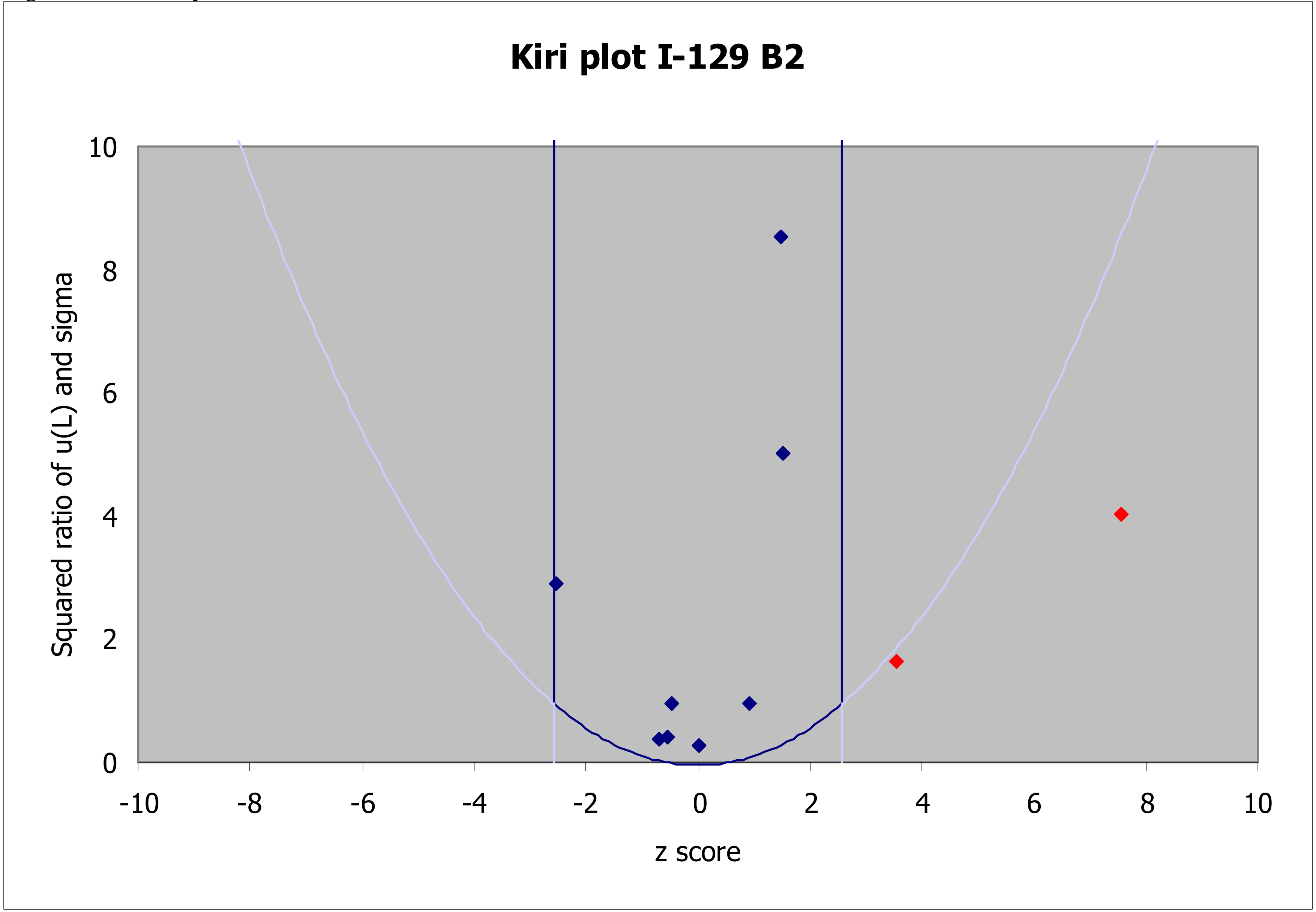


Figure 36A – Deviation Co-60 GL

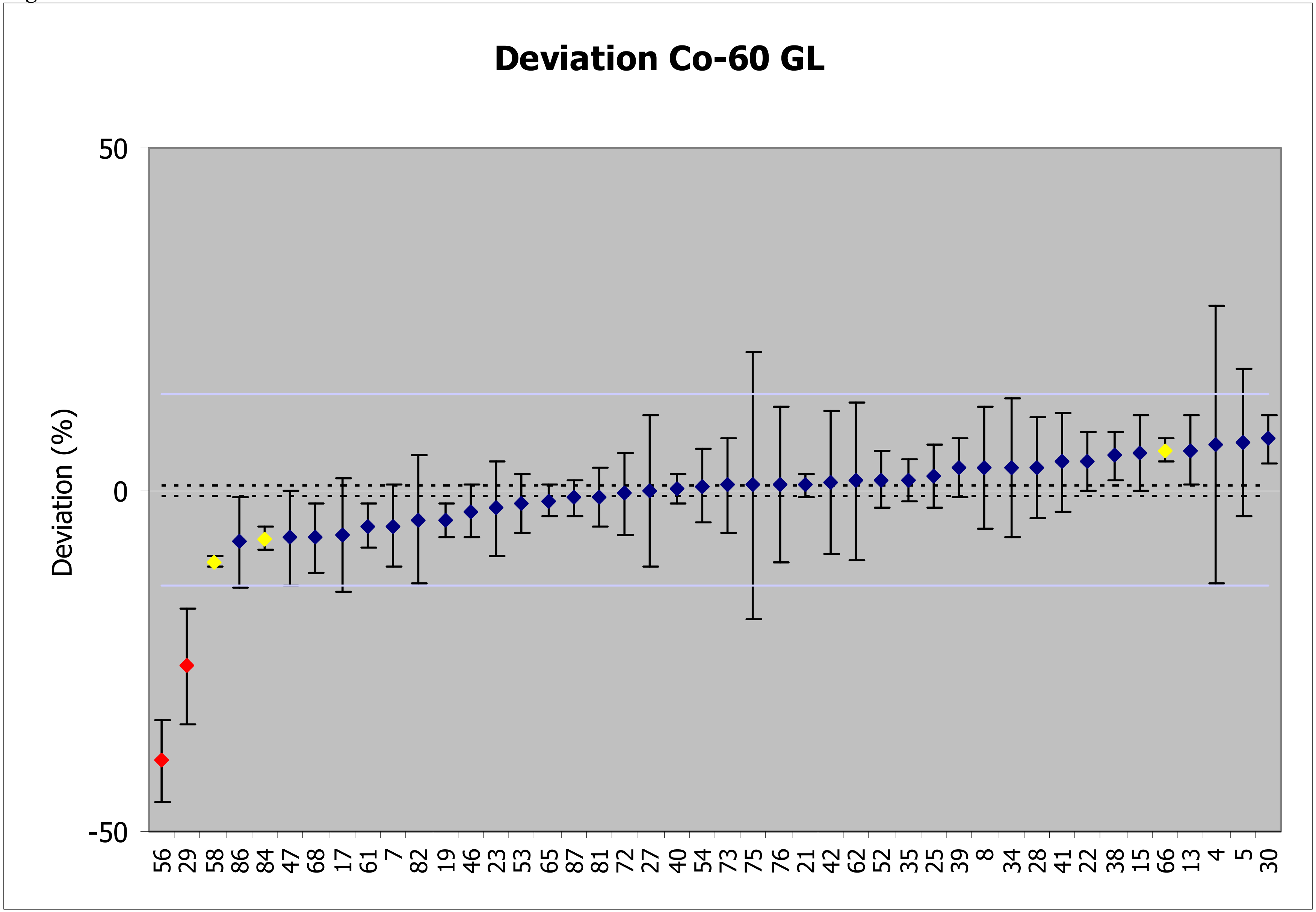


Figure 36B – Zeta score Co-60 GL

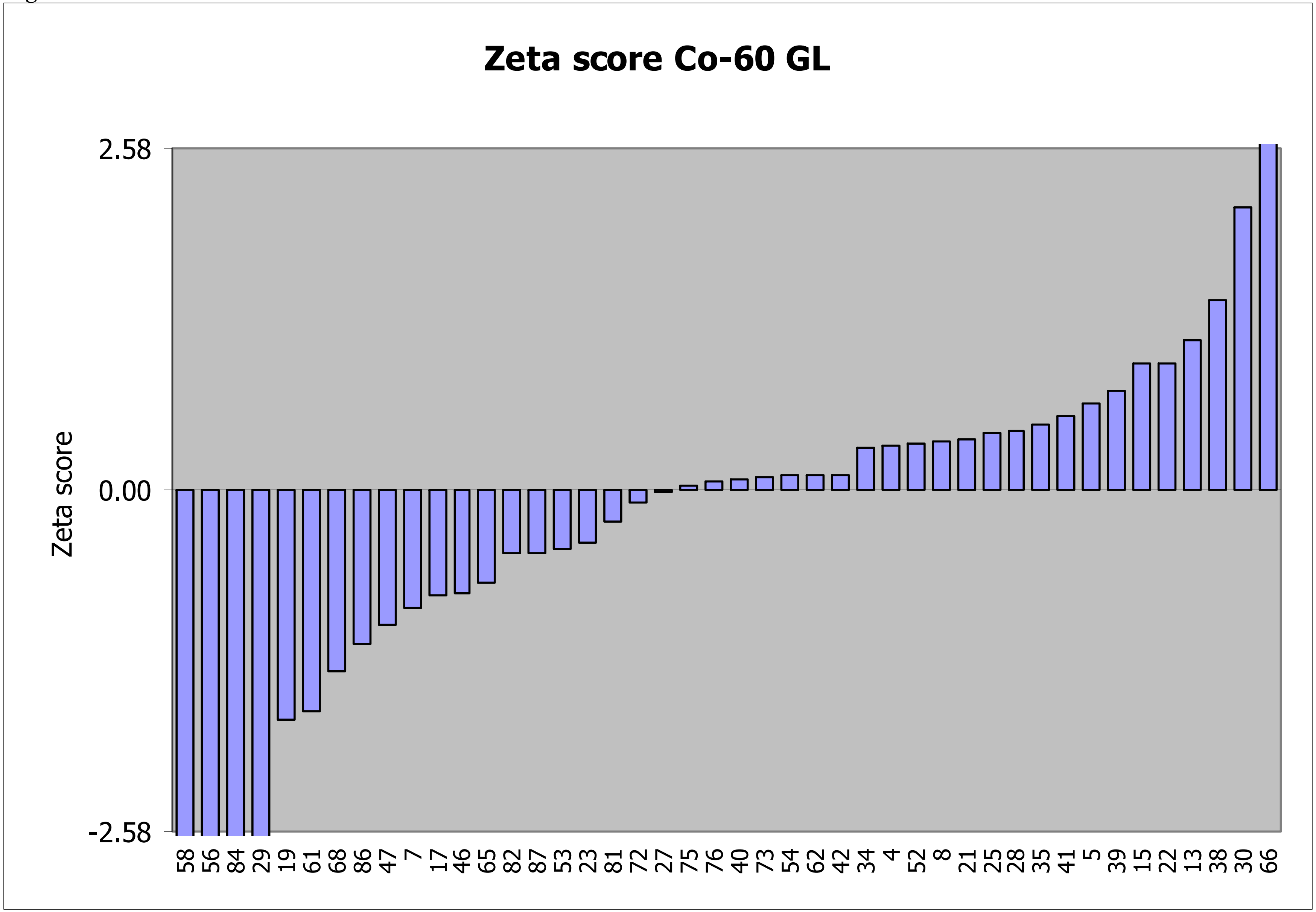


Figure 36C – Relative uncertainty Co-60 GL

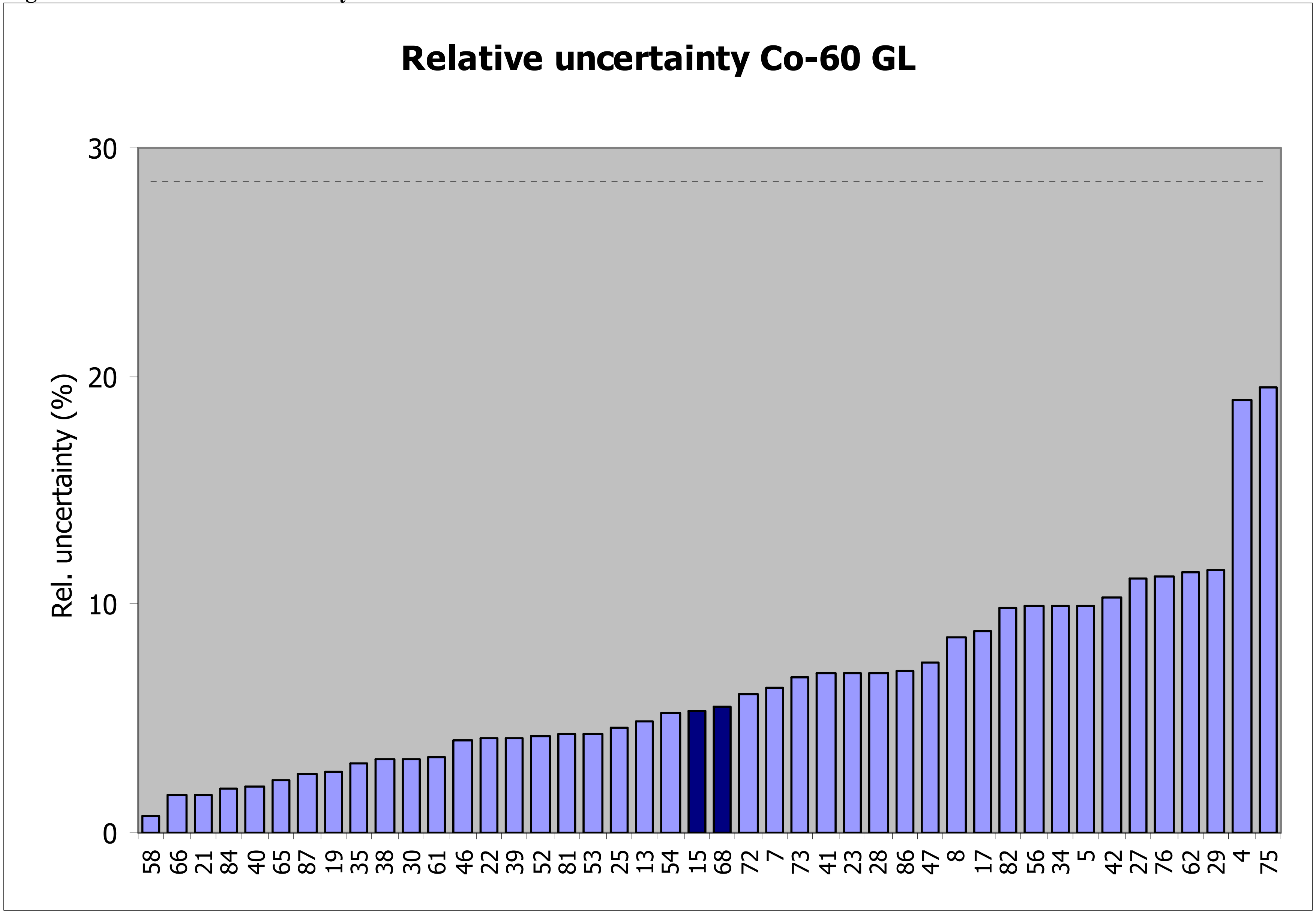


Figure 36D – Kiri plot Co-60 GL

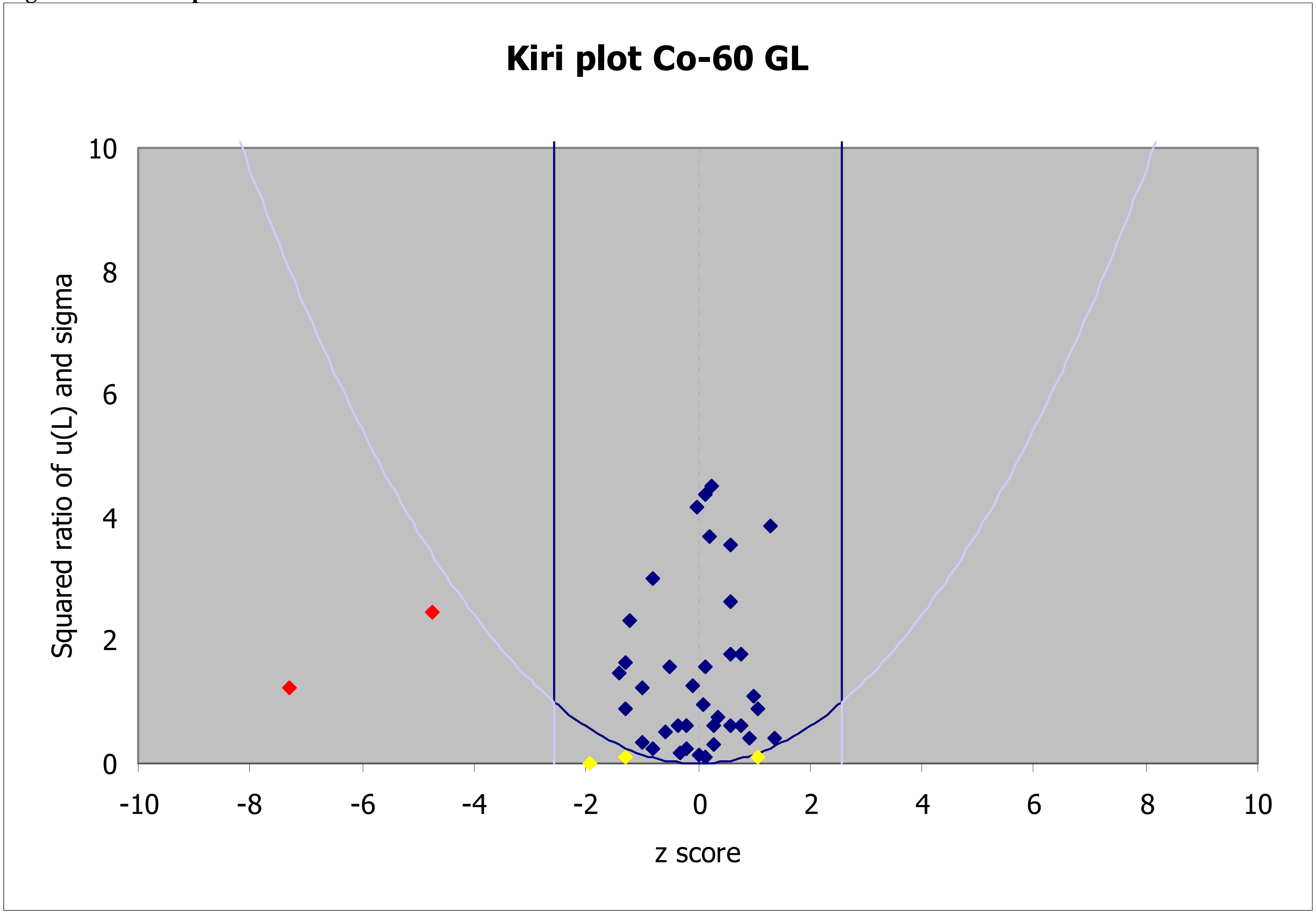


Figure 37A – Deviation Zr-95 GL

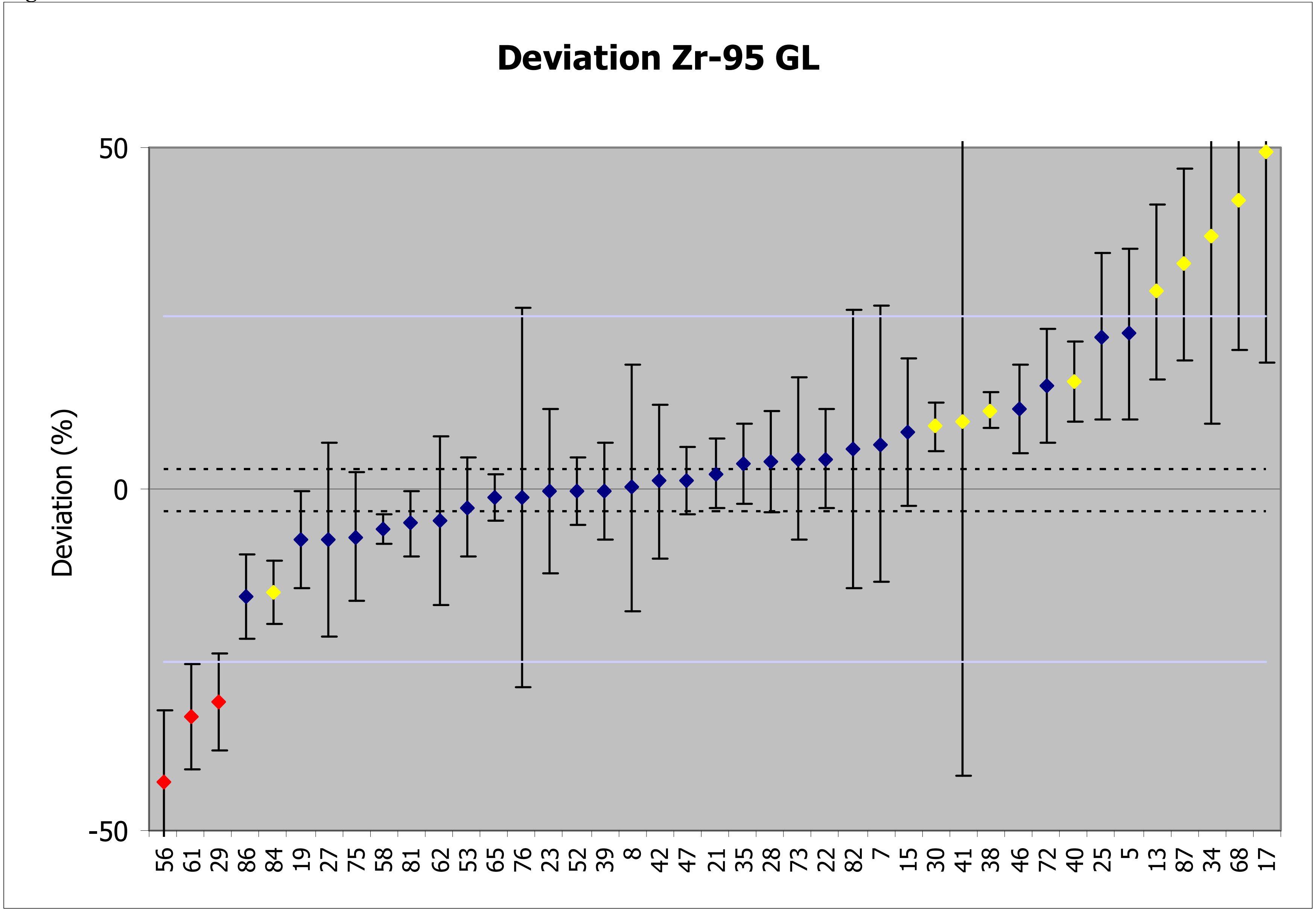


Figure 37B – Zeta score Zr-95 GL

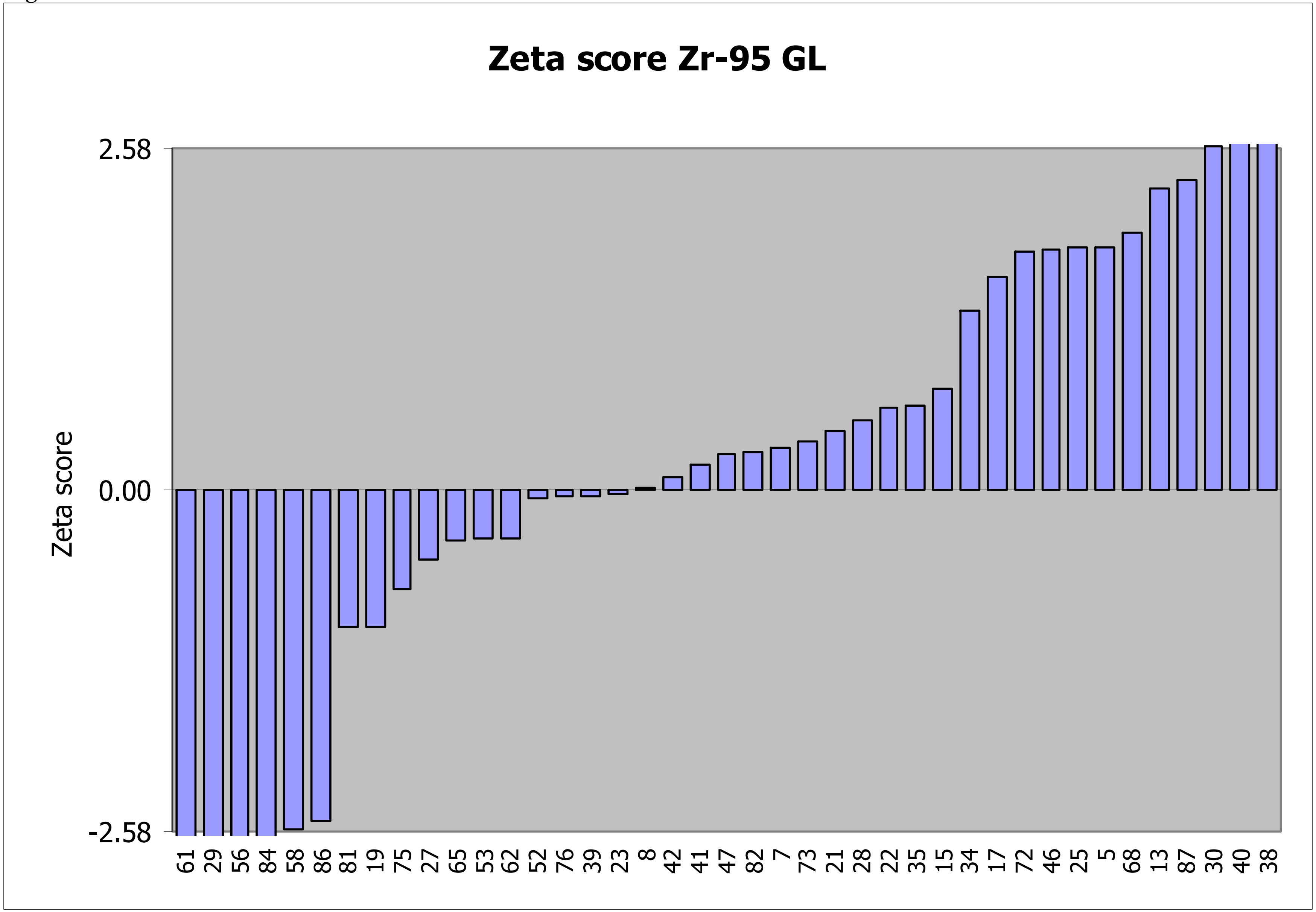


Figure 37C – Relative uncertainty Zr-95 GL

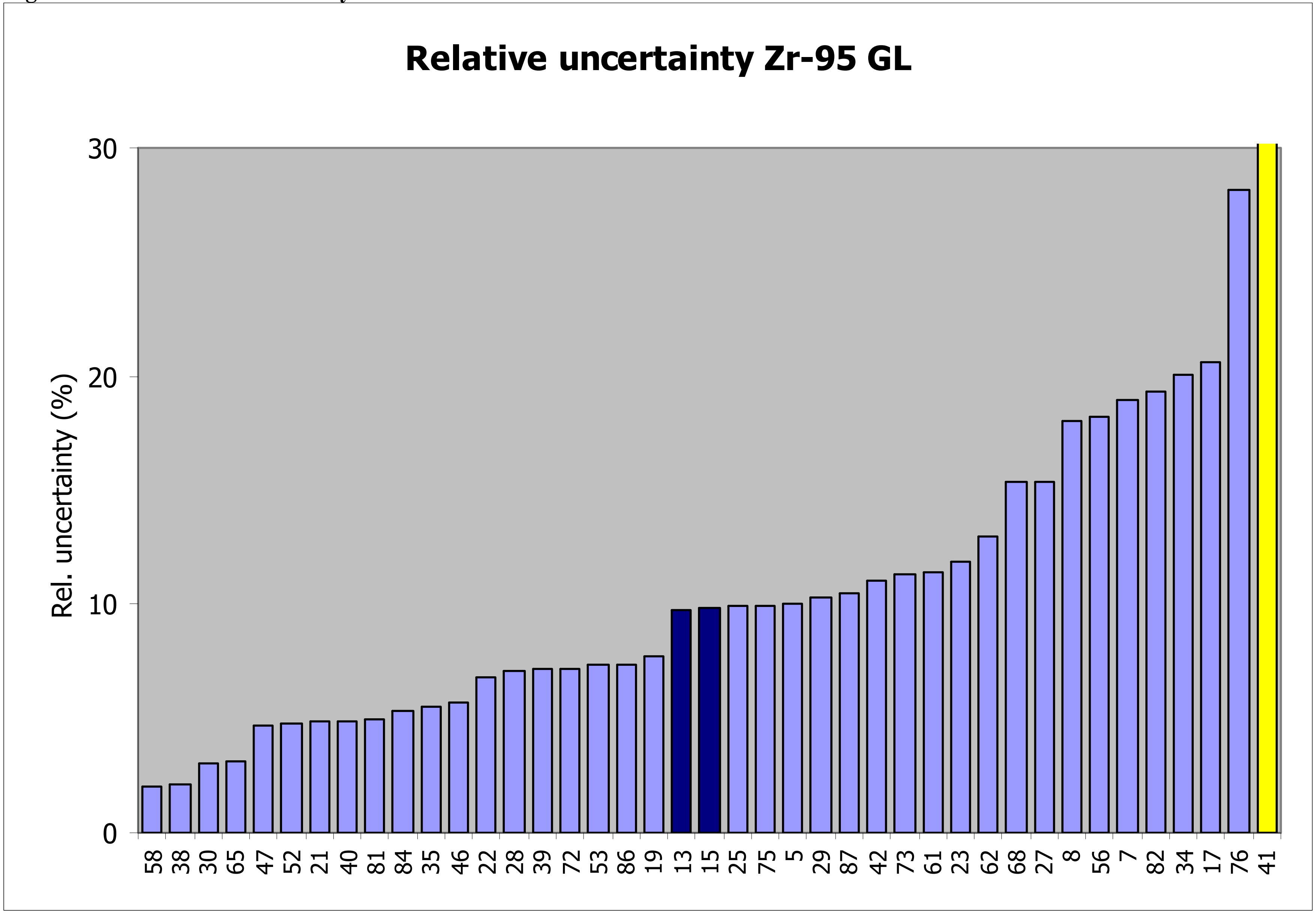


Figure 37D – Kiri plot Zr-95 GL

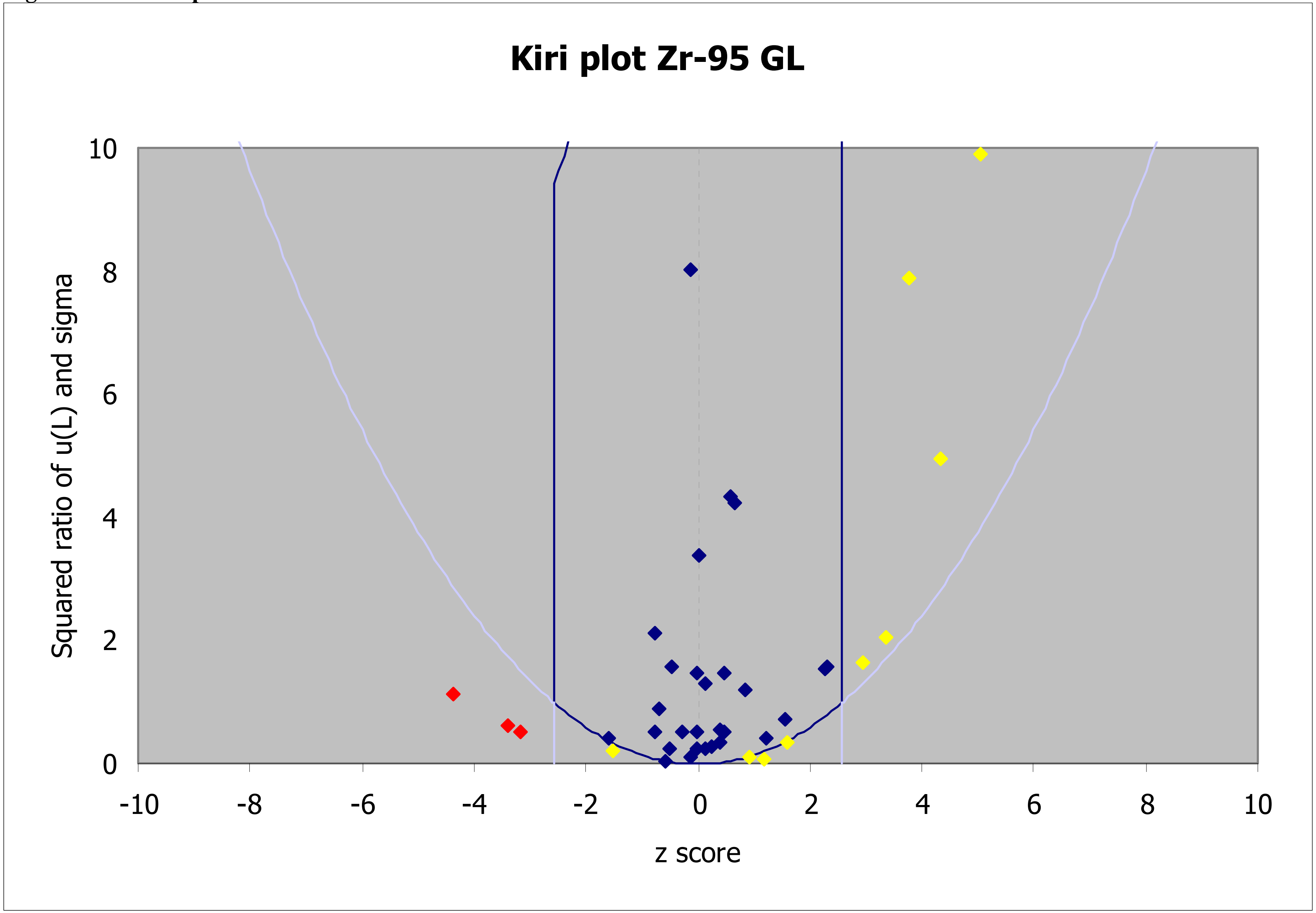


Figure 38A – Deviation Nb-95 GL

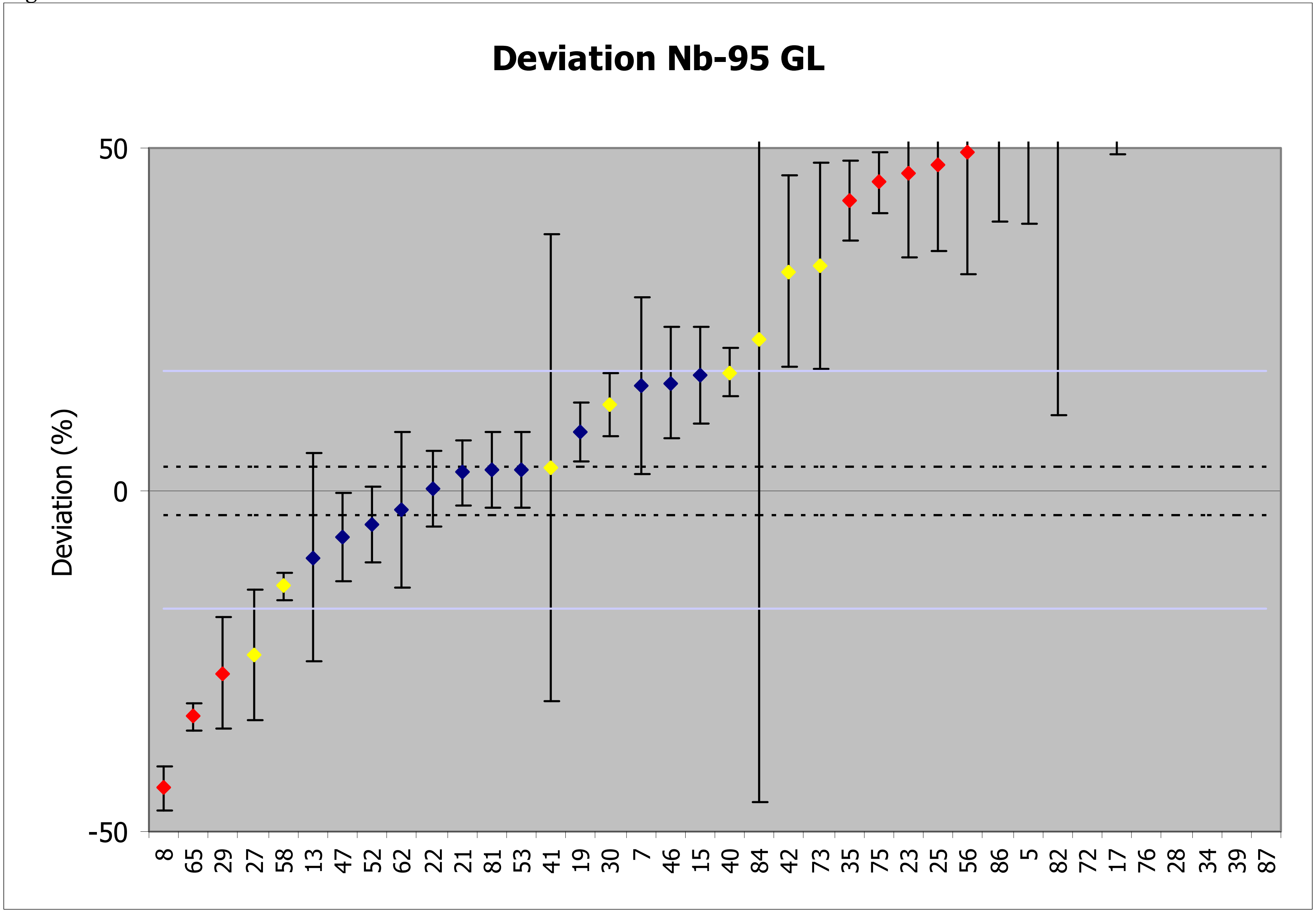


Figure 38B – Zeta score Nb-95 GL

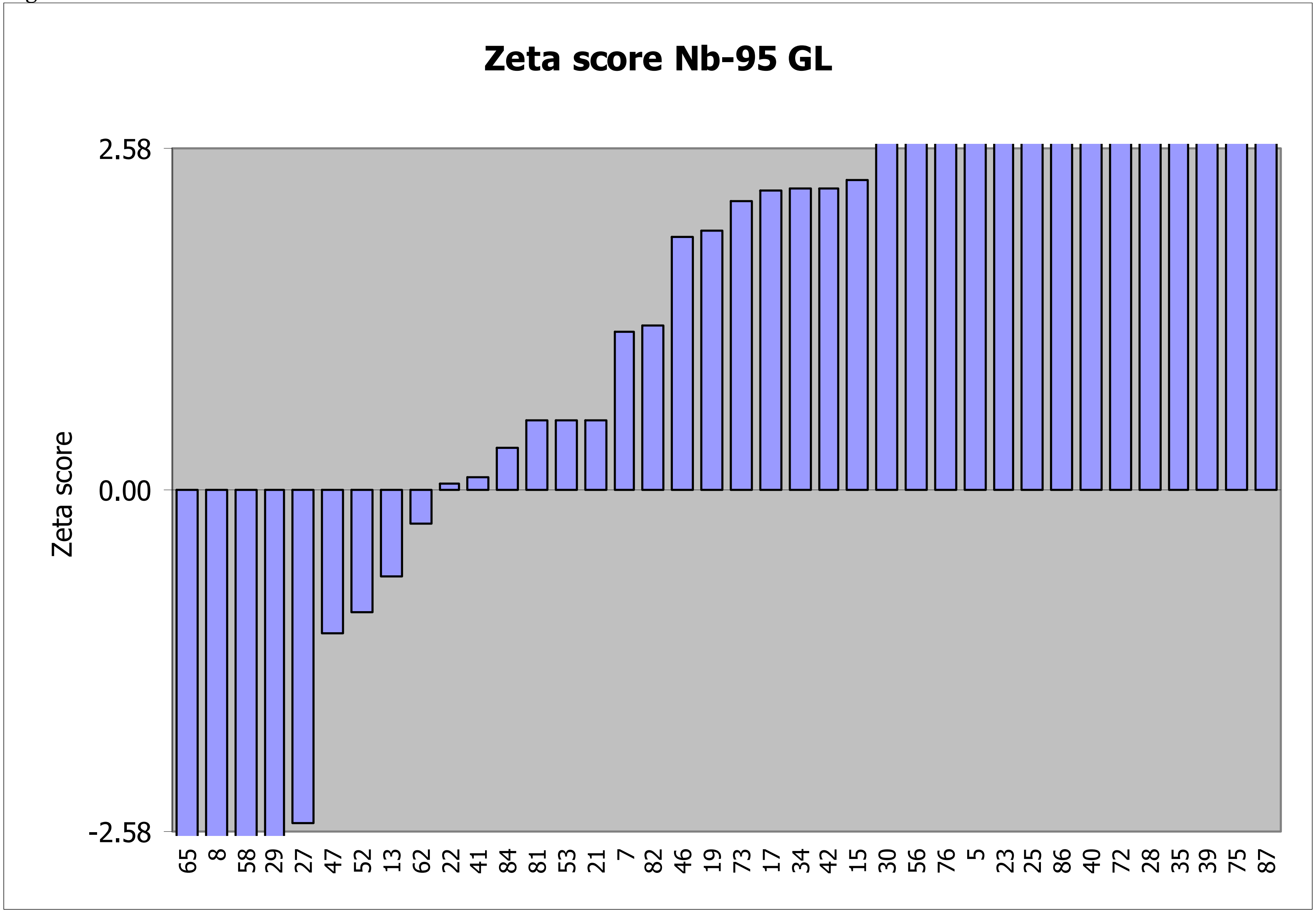


Figure 38C – Relative uncertainty Nb-95 GL

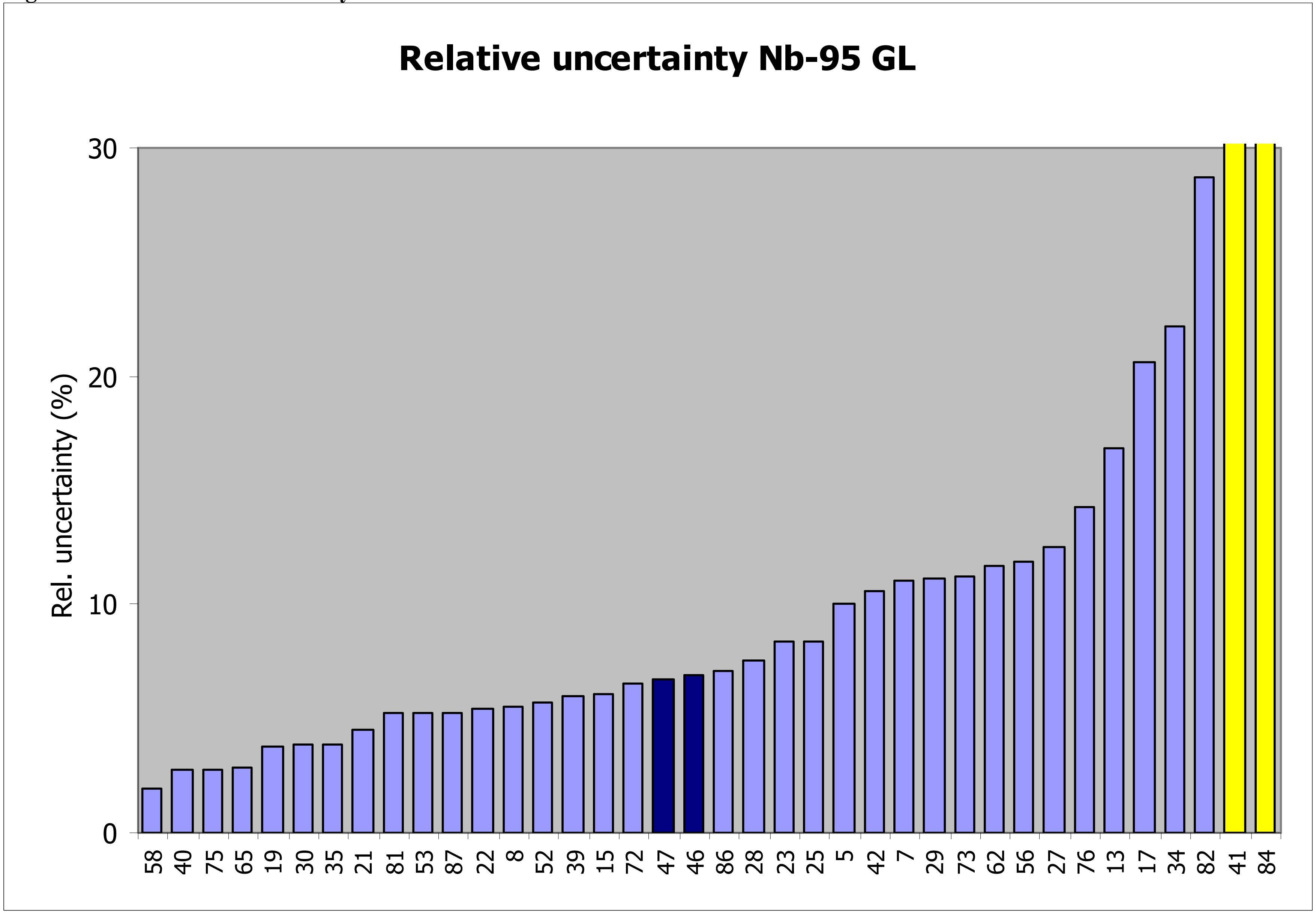


Figure 38D – Kiri plot Nb-95 GL

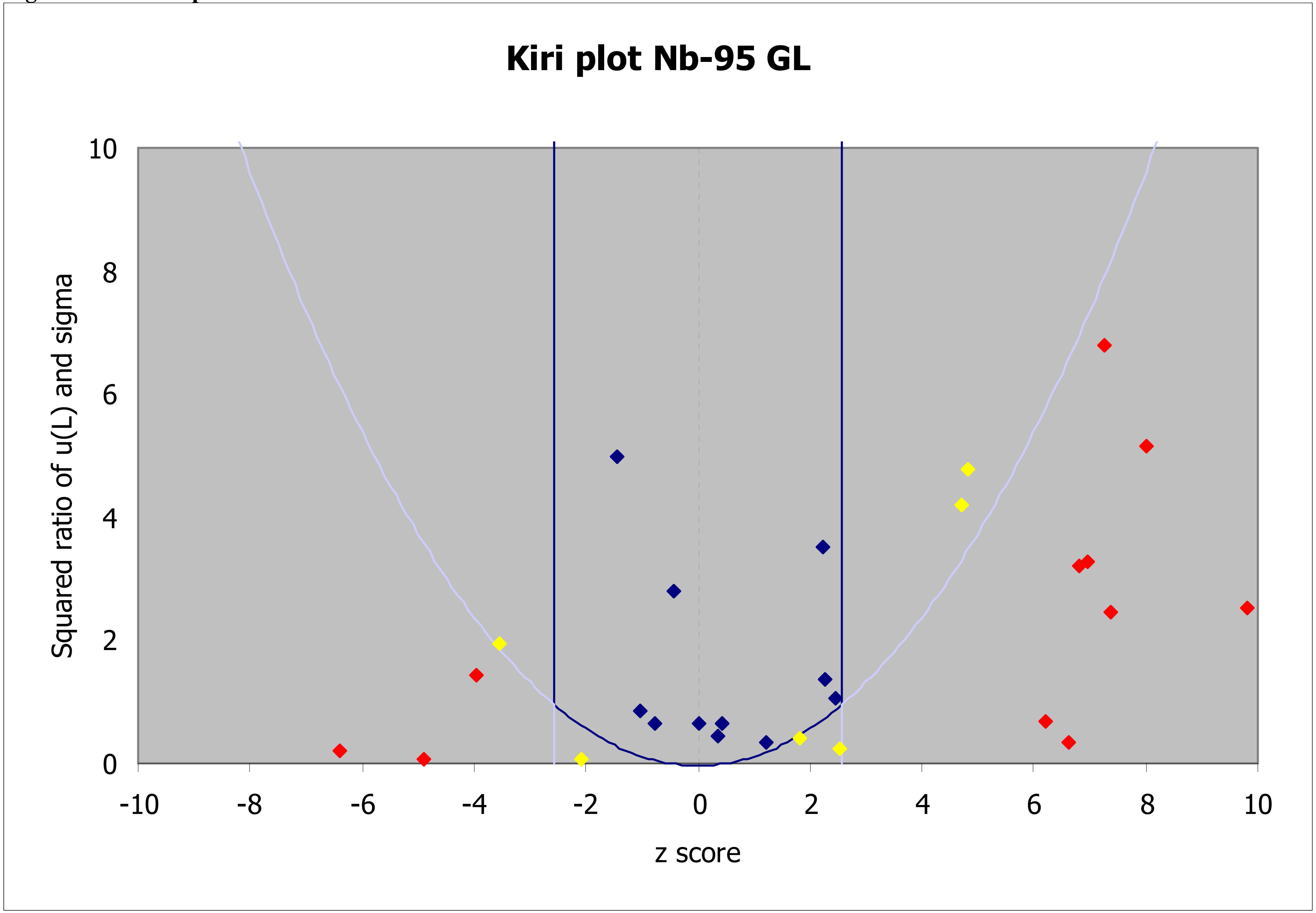


Figure 39A – Deviation Sb-125 GL

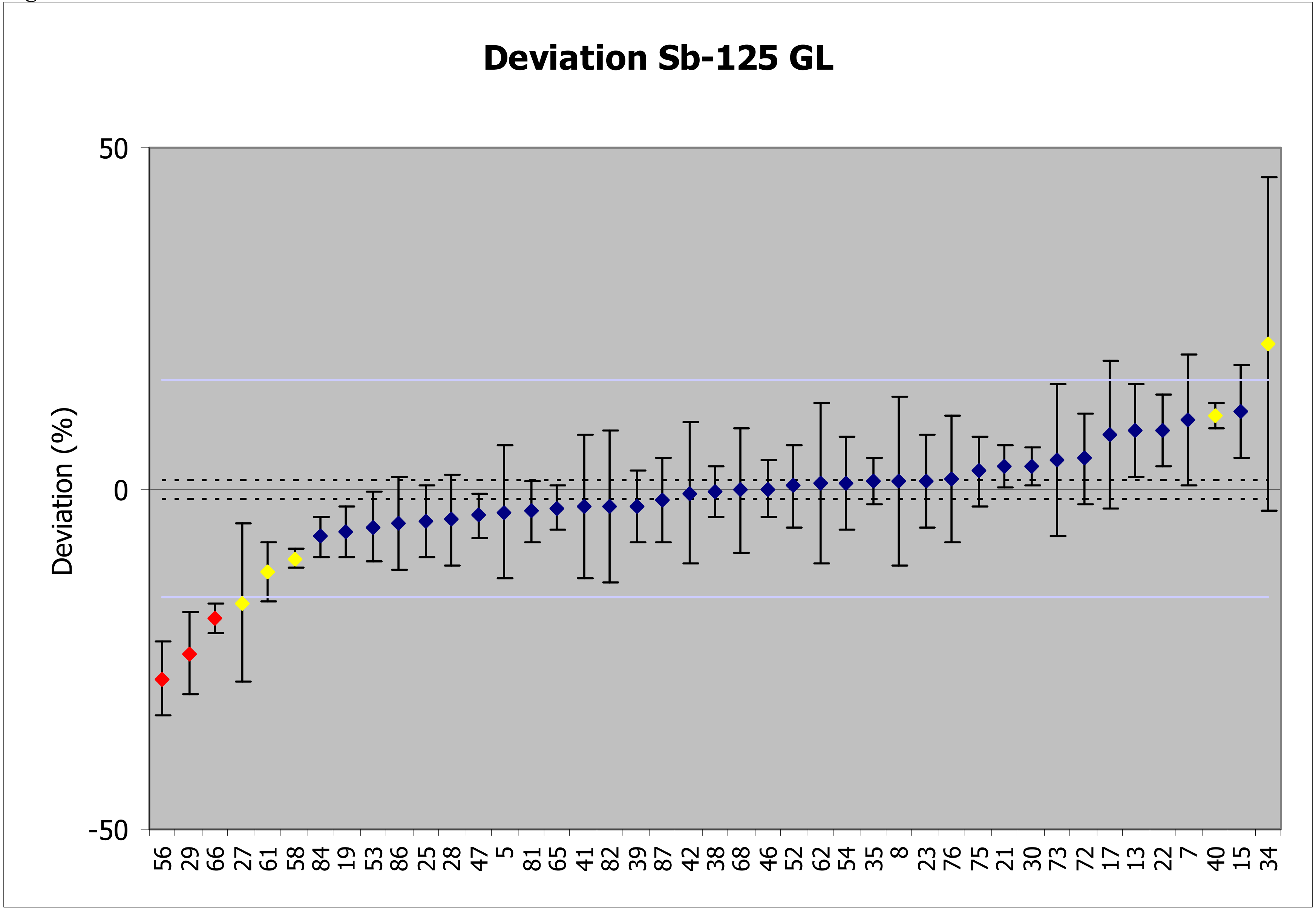


Figure 39B – Zeta score Sb-125 GL

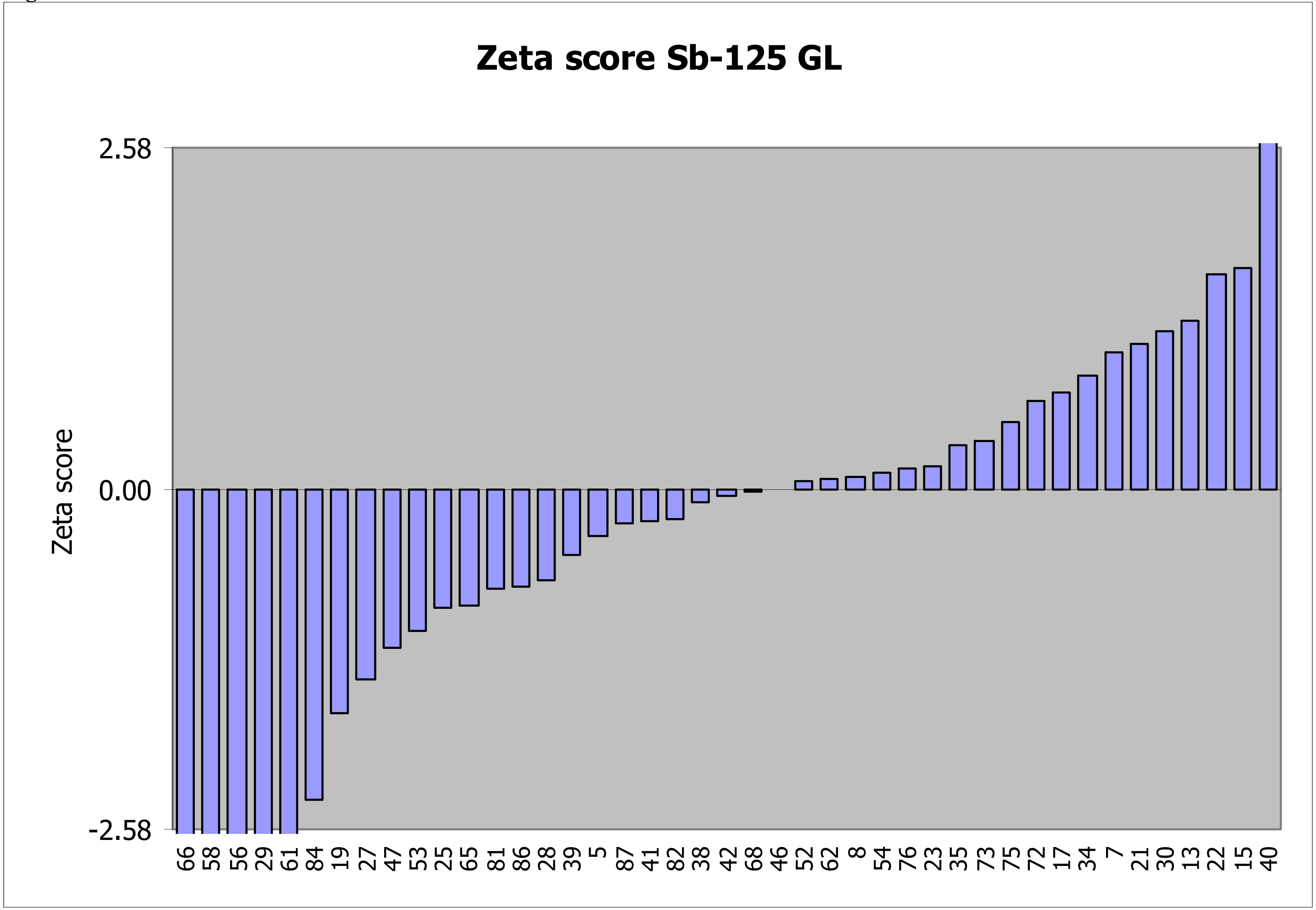


Figure 39C – Relative uncertainty Sb-125 GL

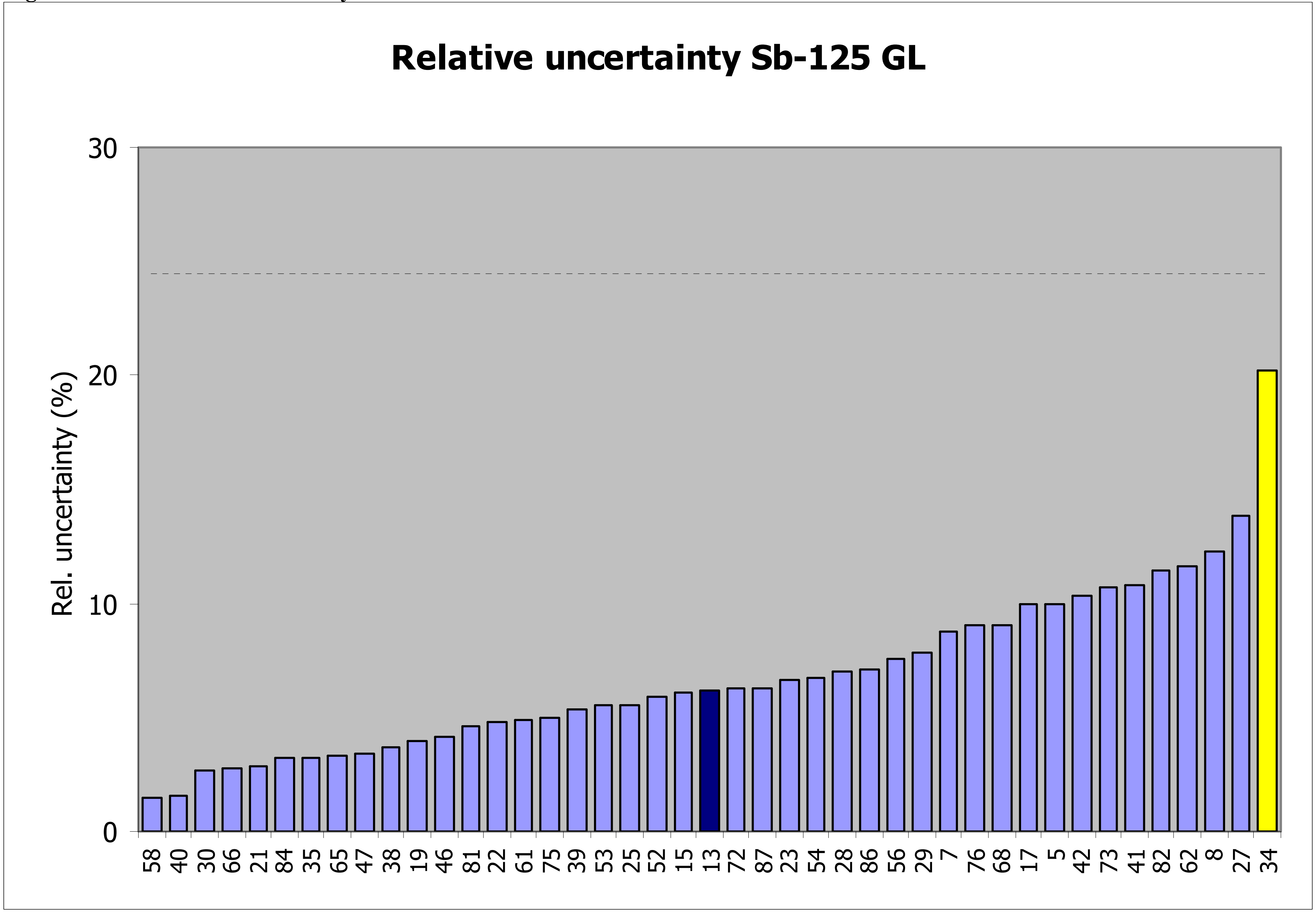


Figure 39D – Kiri plot Sb-125 GL

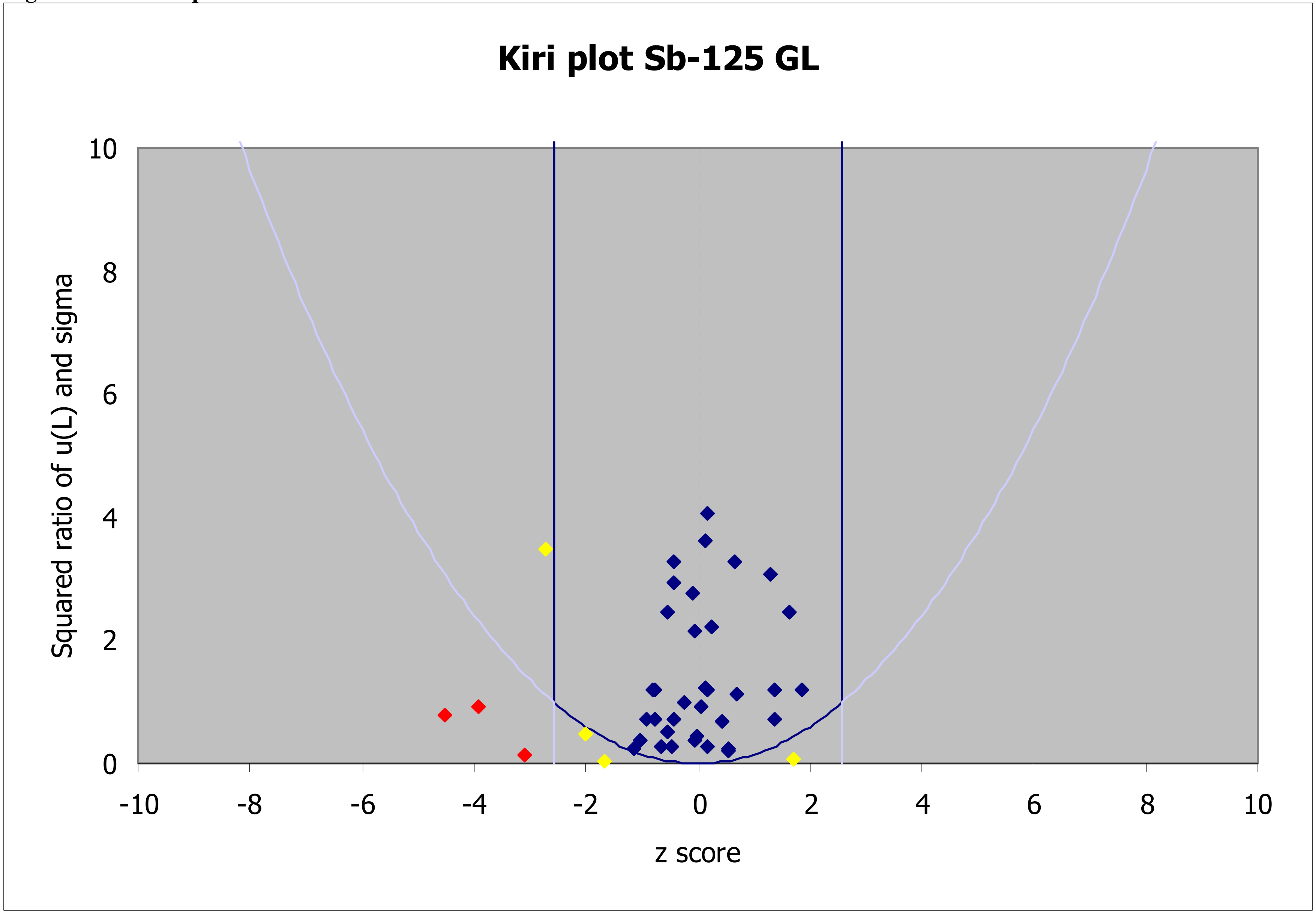


Figure 40A – Deviation Ba-133 GL

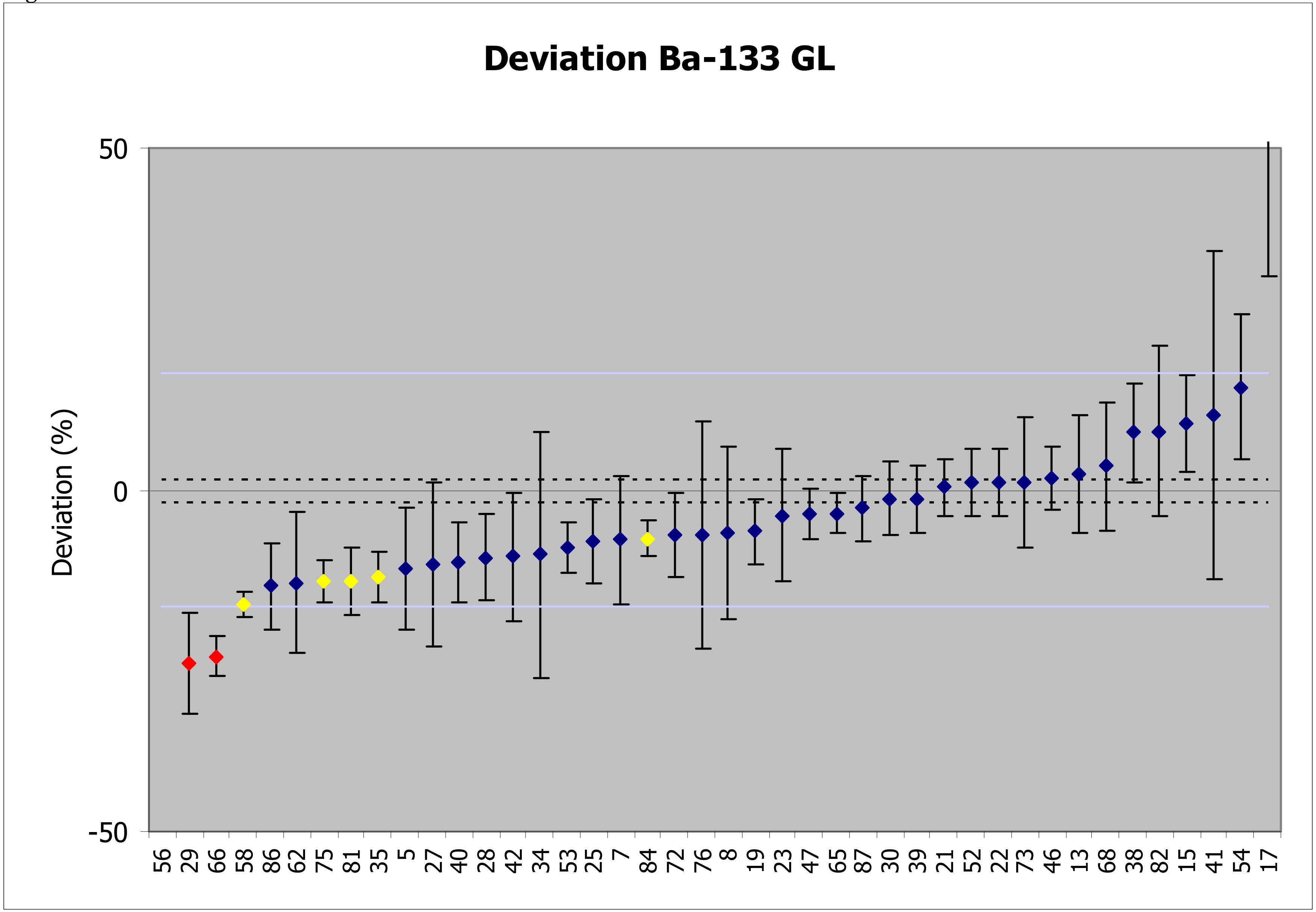


Figure 40B – Zeta score Ba-133 GL

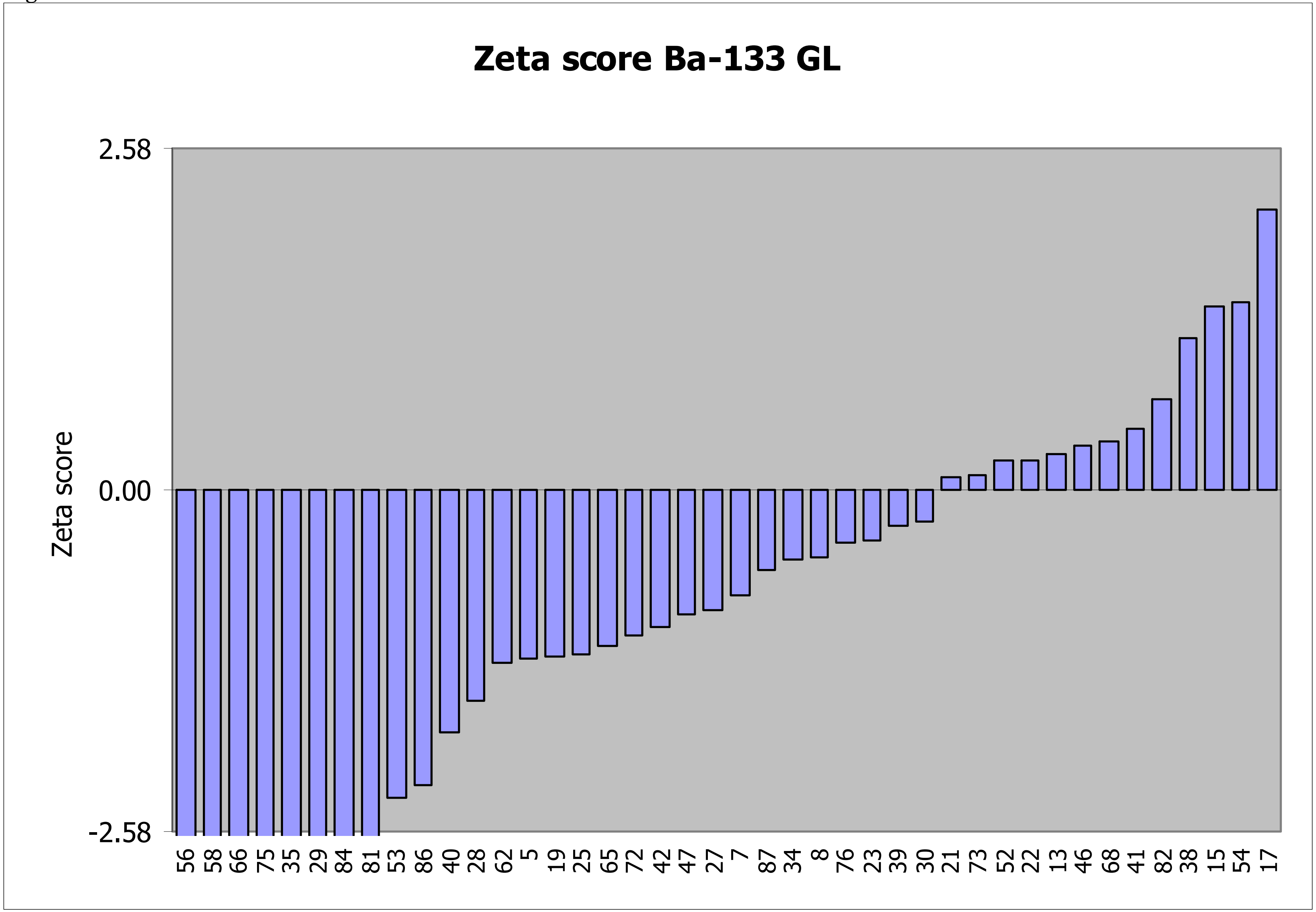


Figure 40C – Relative uncertainty Ba-133 GL

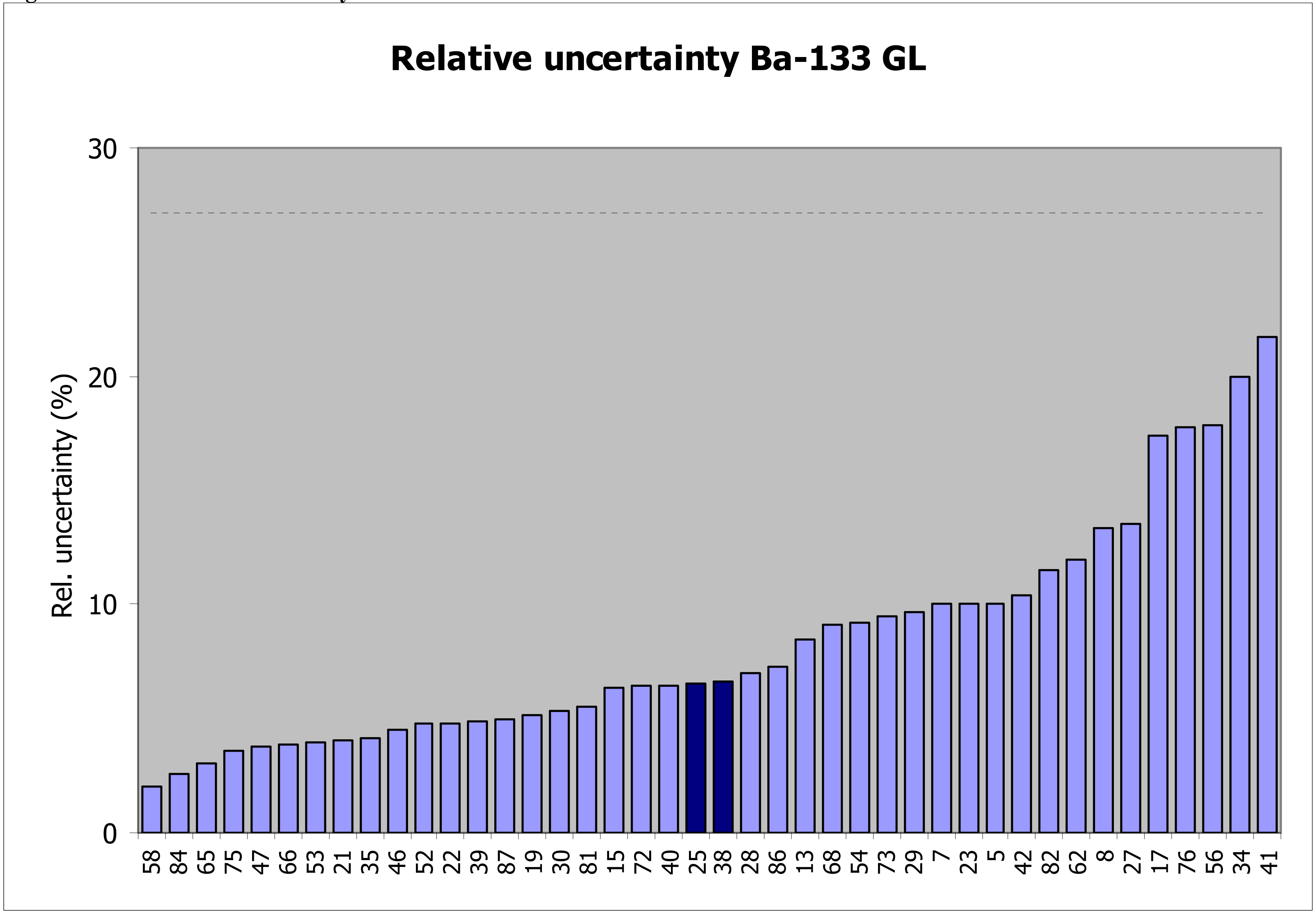


Figure 40D – Kiri plot Ba-133 GL

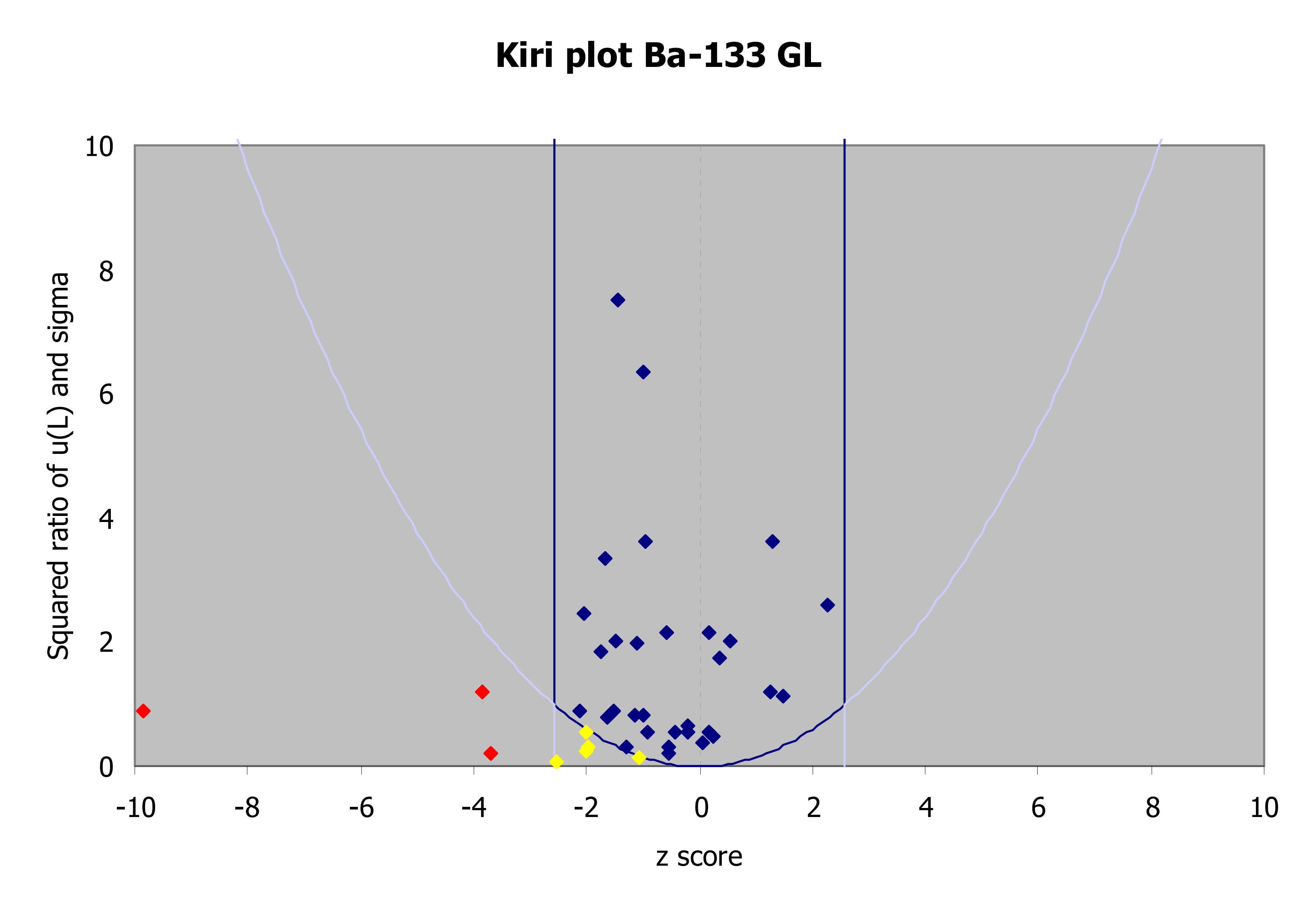


Figure 41A – Deviation Cs-134 GL

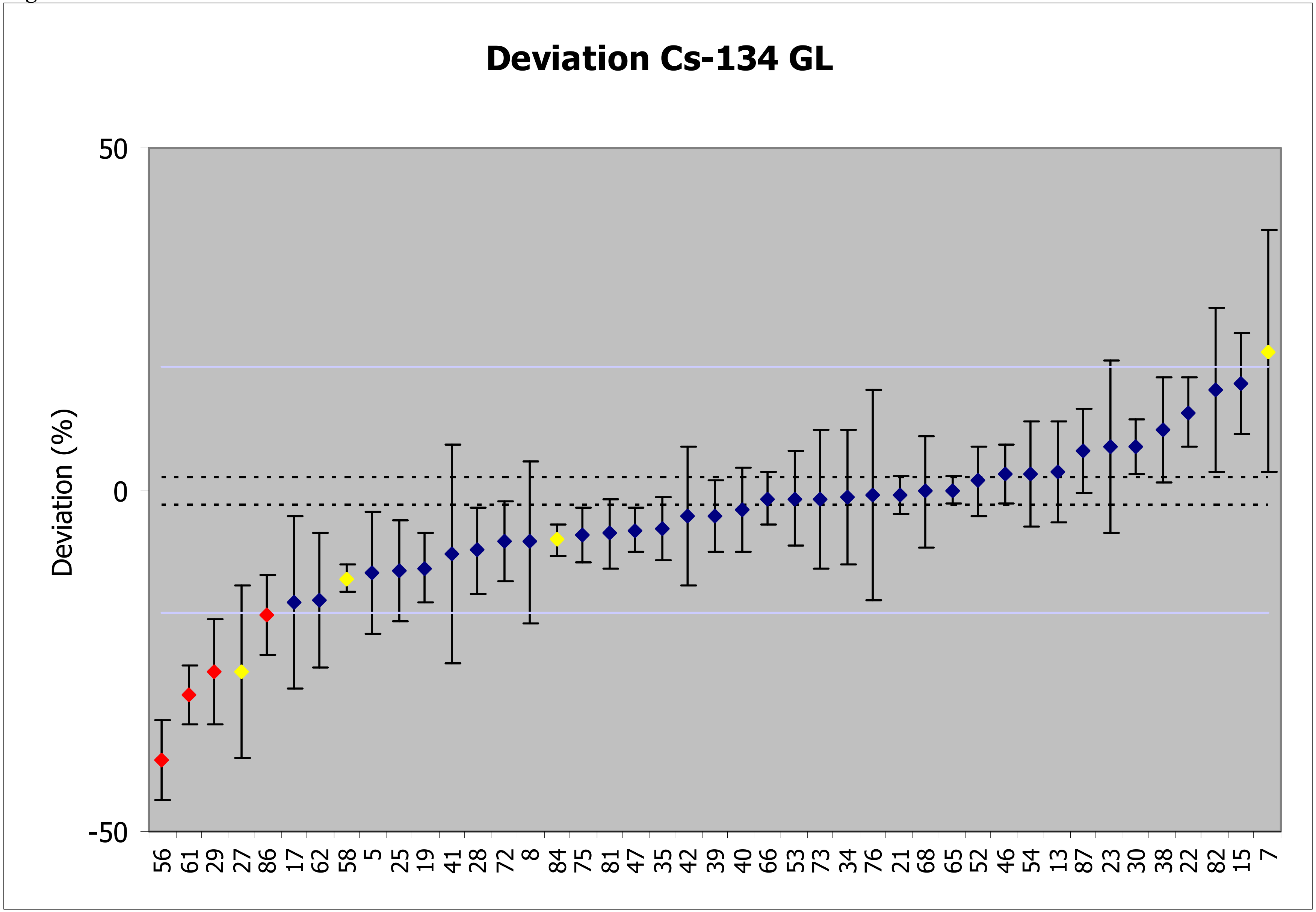


Figure 41B – Zeta score Cs-134 GL

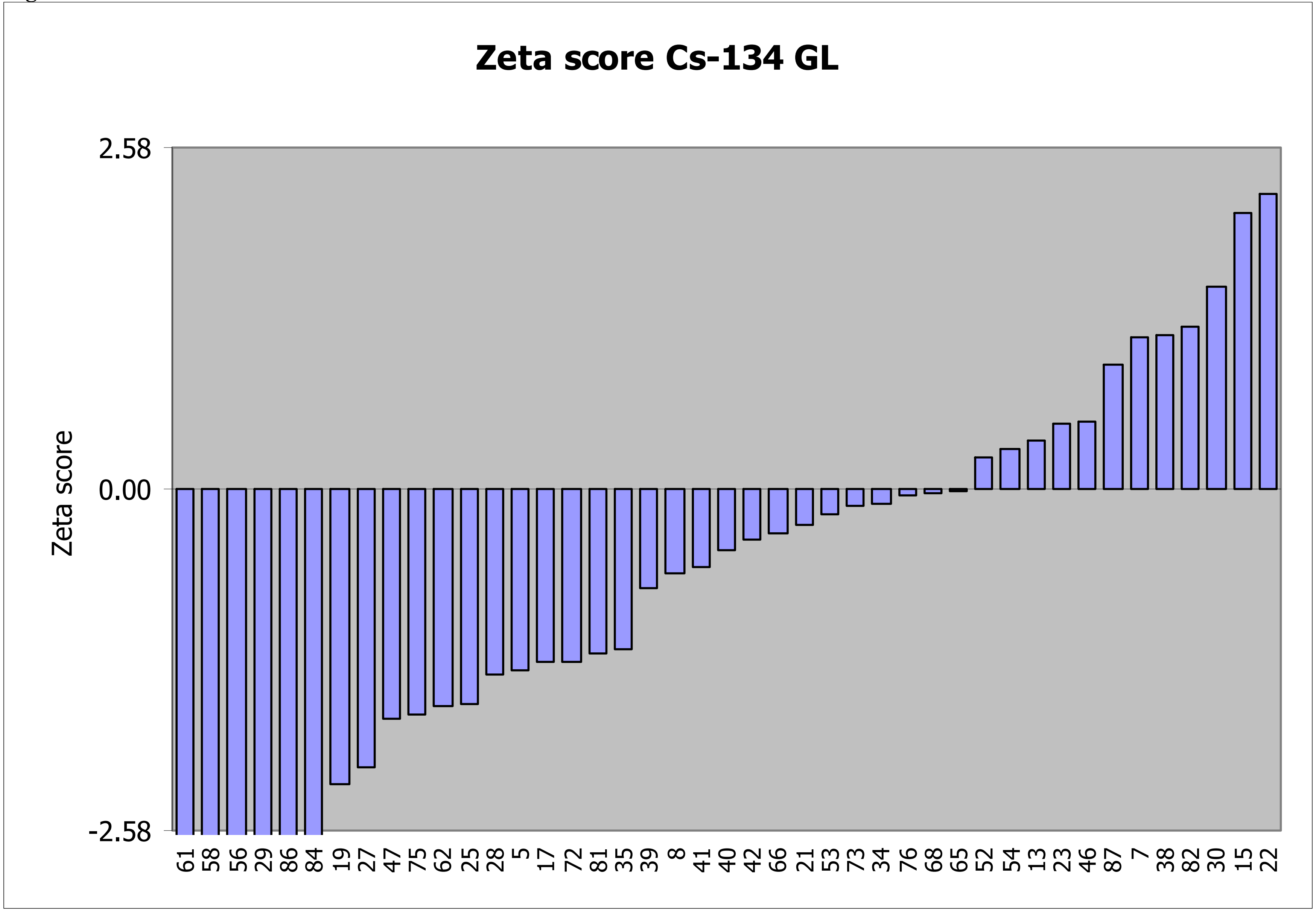


Figure 41C – Relative uncertainty Cs-134 GL

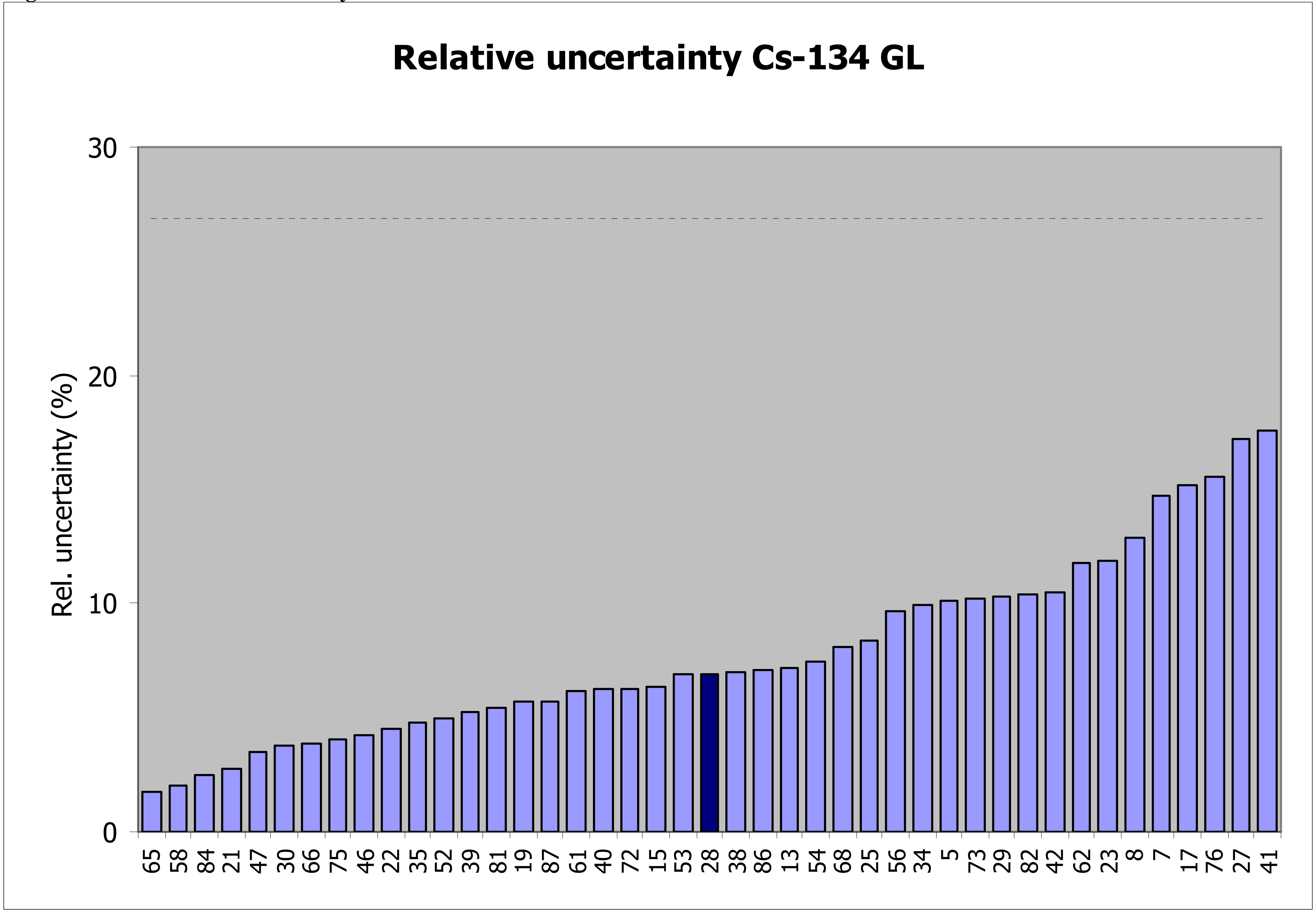


Figure 41D – Kiri plot Cs-134 GL

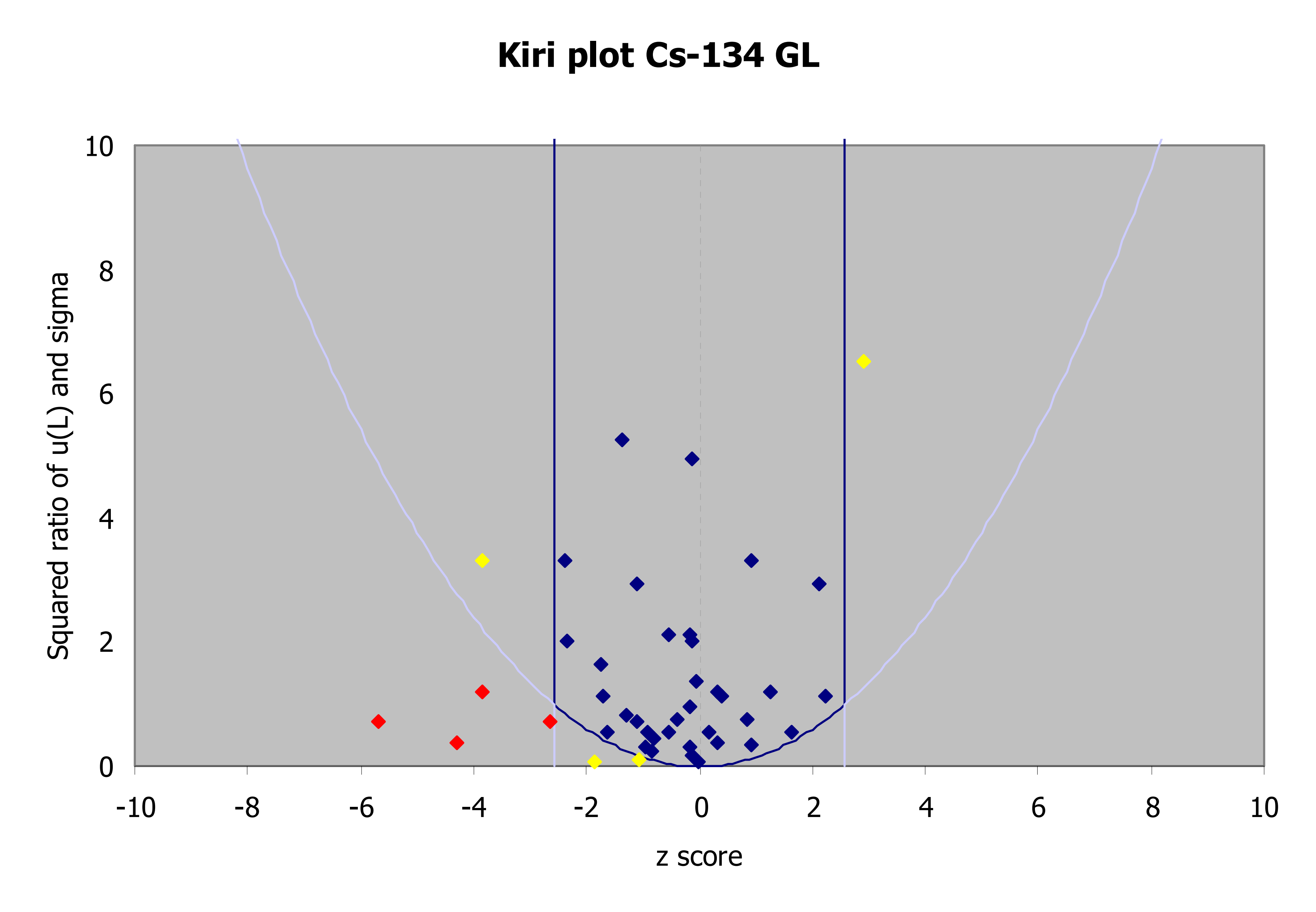


Figure 42A – Deviation Cs-137 GL

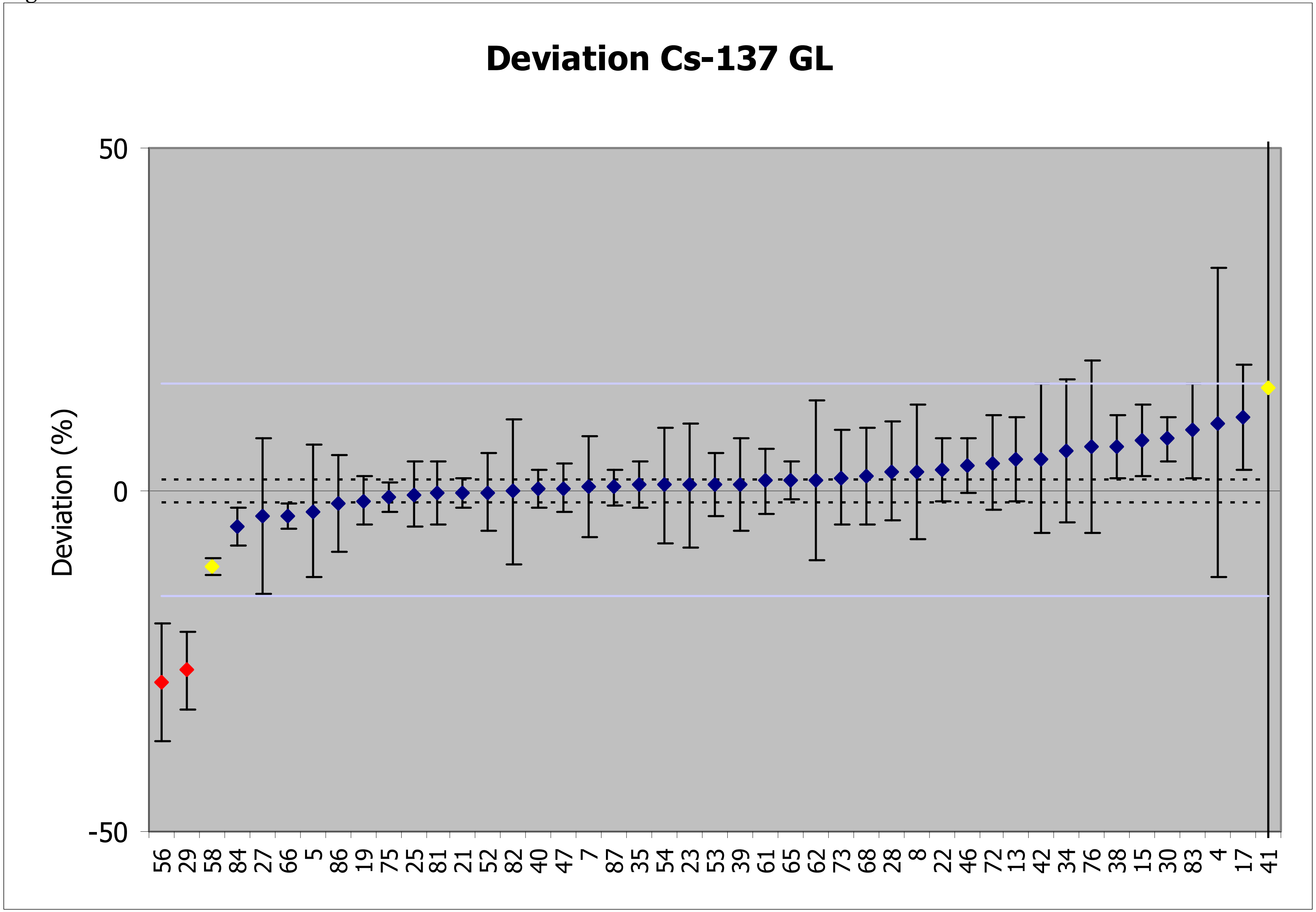


Figure 42B – Zeta score Cs-137 GL

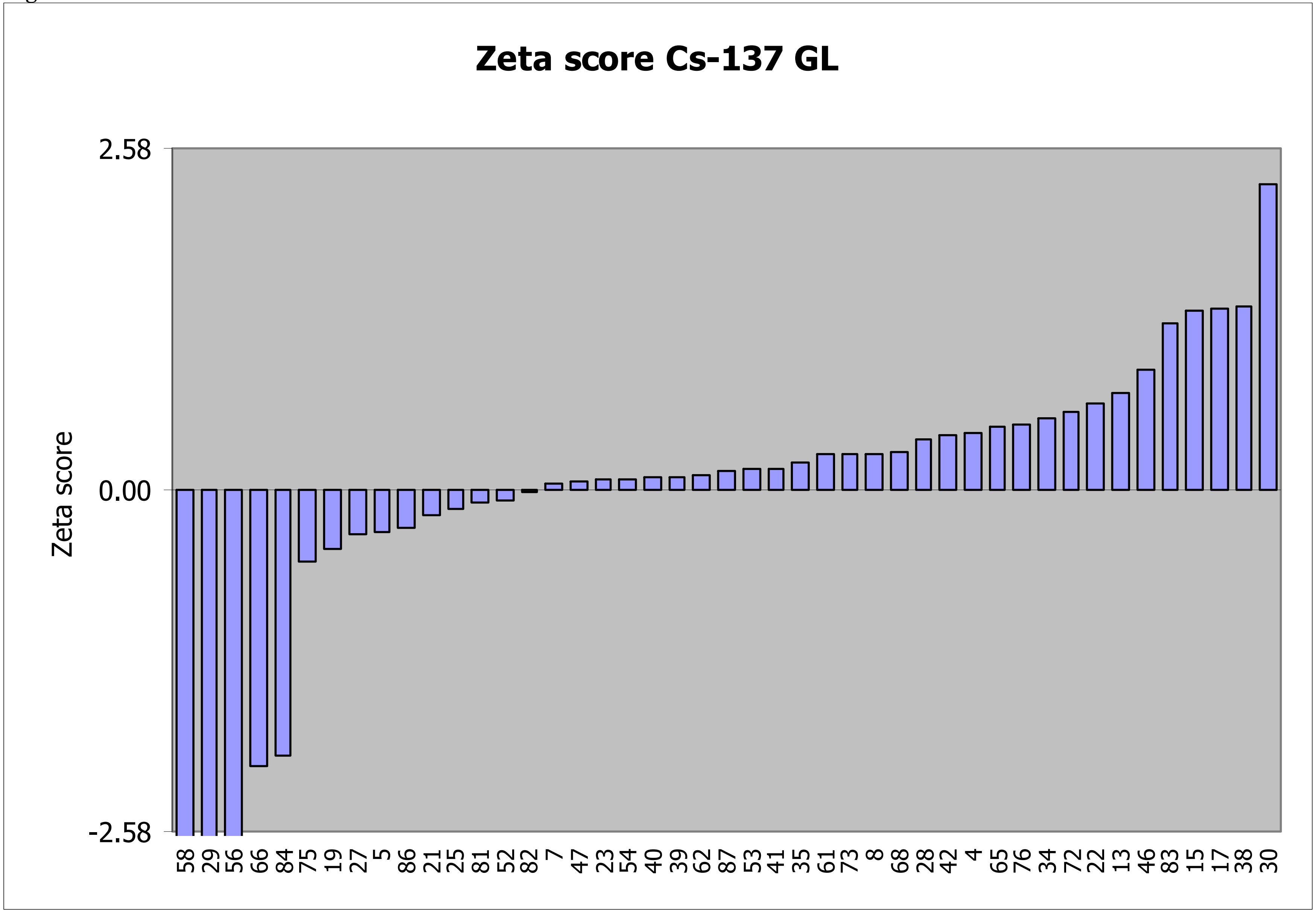


Figure 42C – Relative uncertainty Cs-137 GL

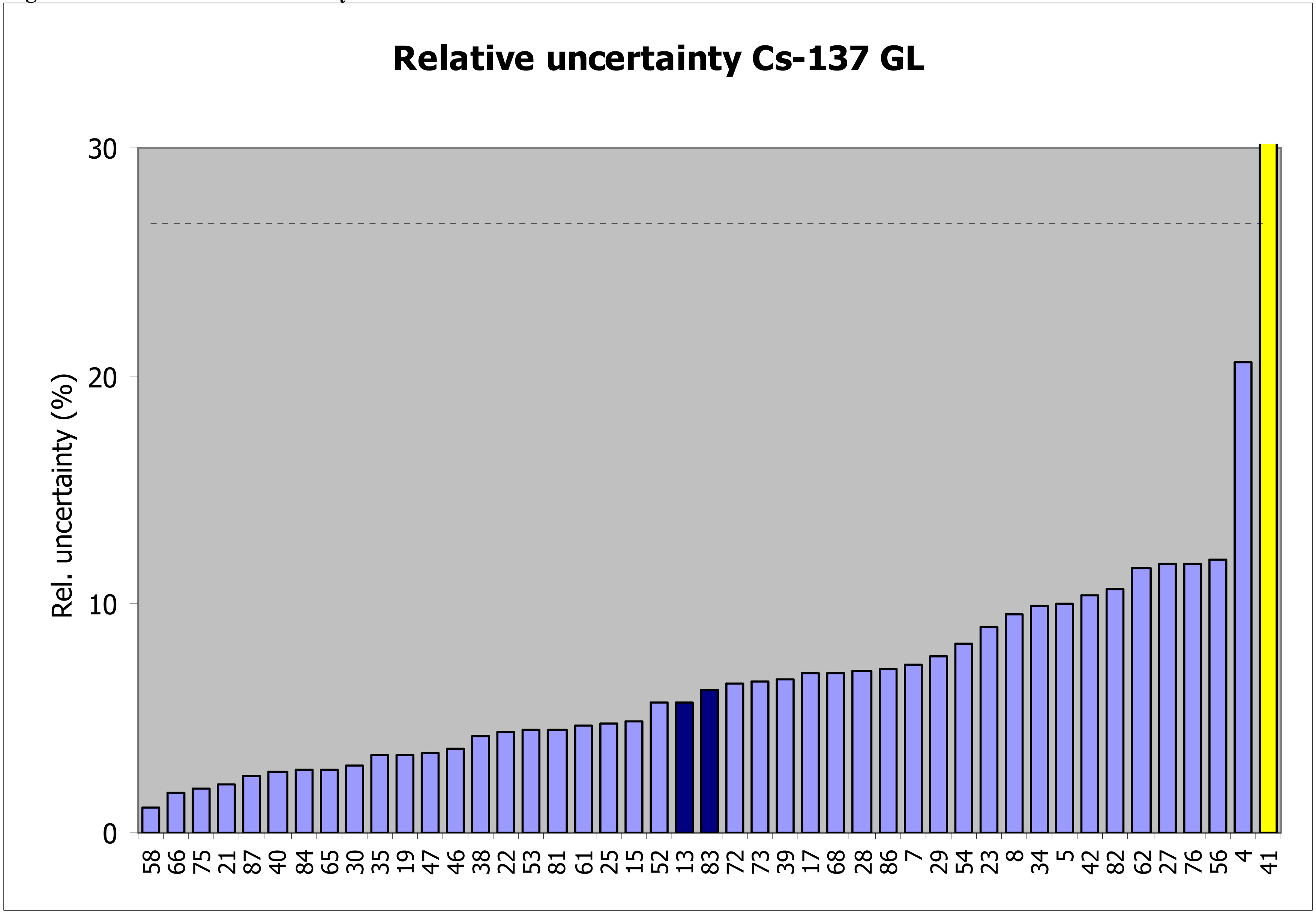


Figure 42D – Kiri plot Cs-137 GL

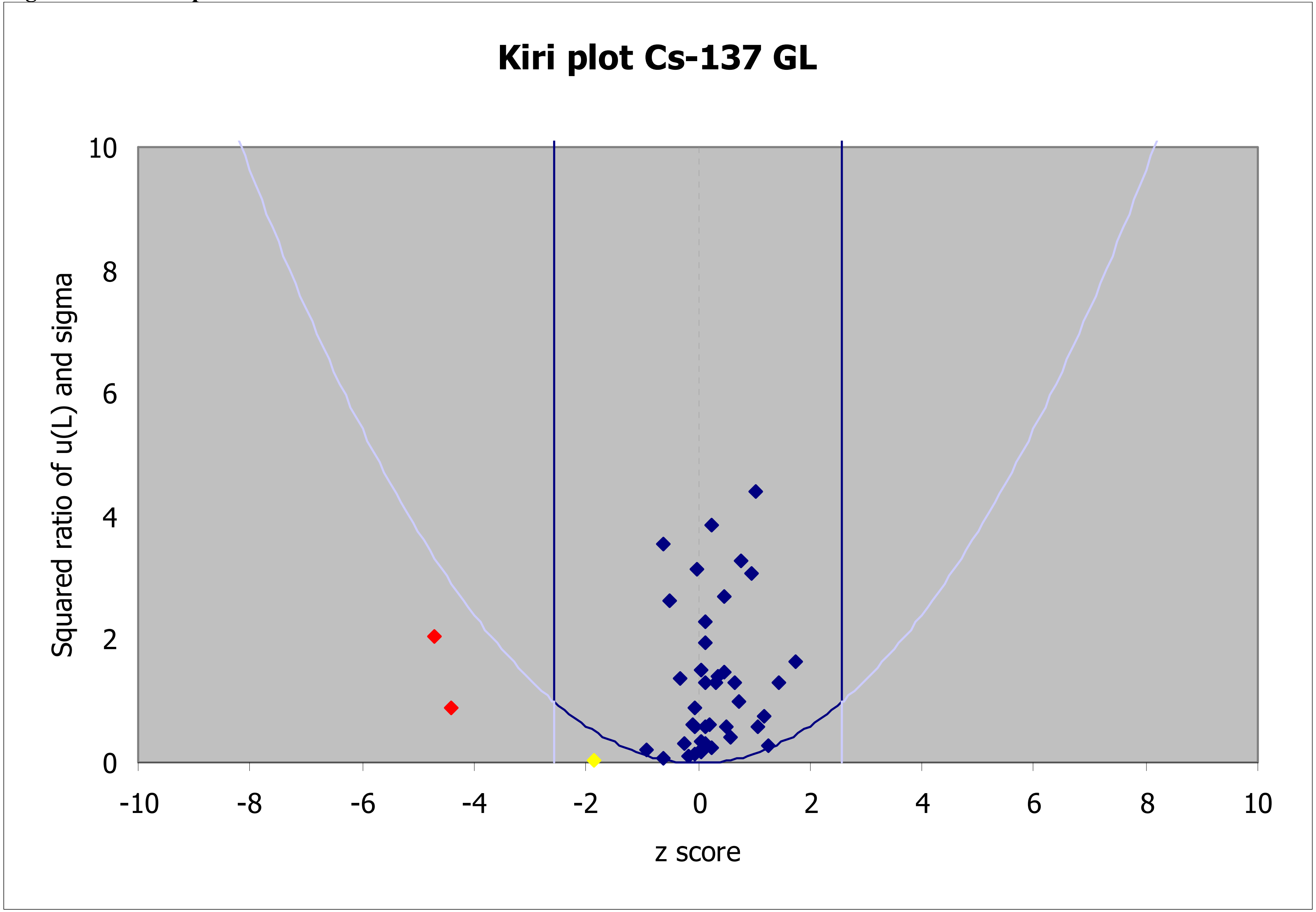


Figure 43A – Deviation Ce-144 GL

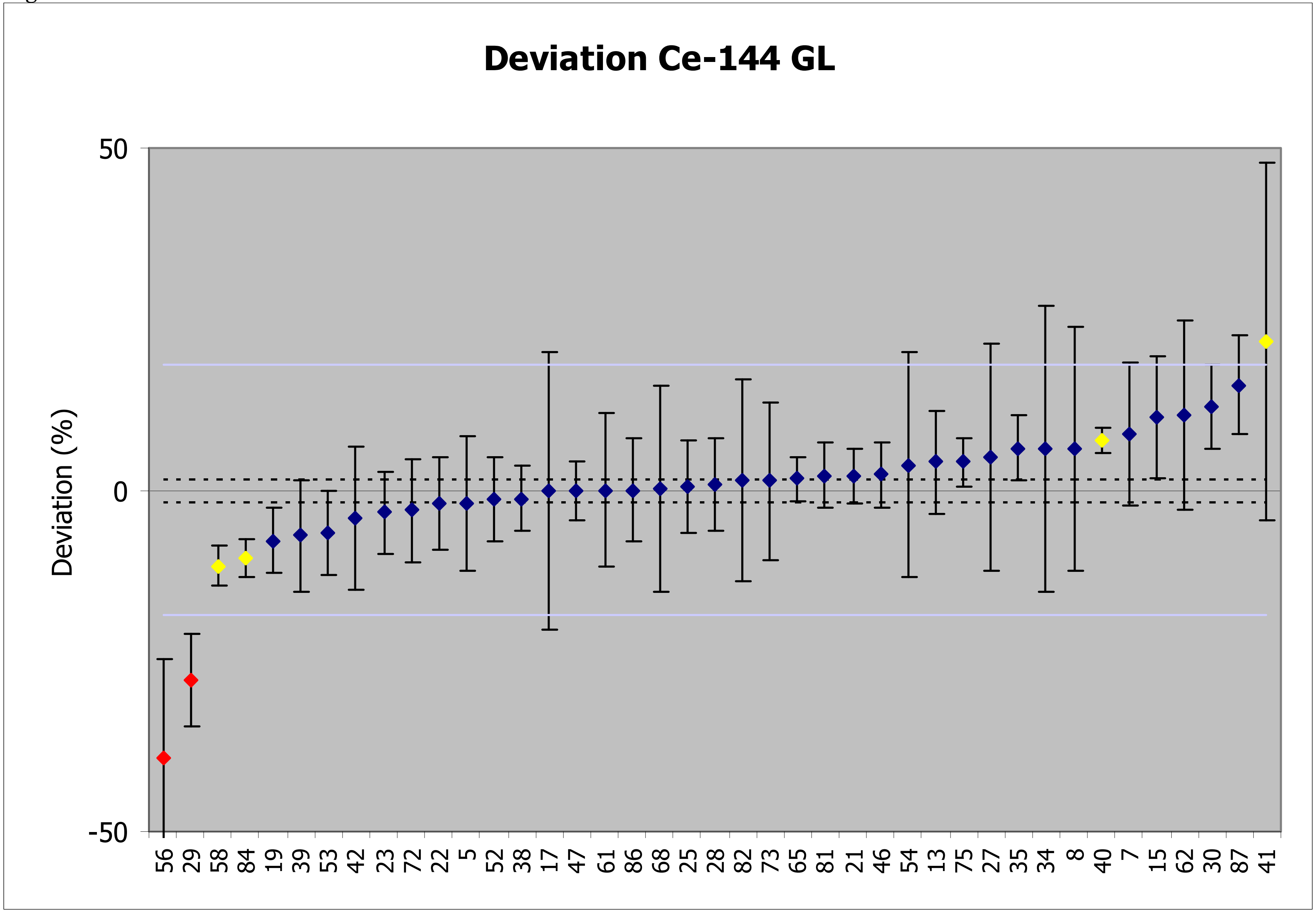


Figure 43B – Zeta score Ce-144 GL

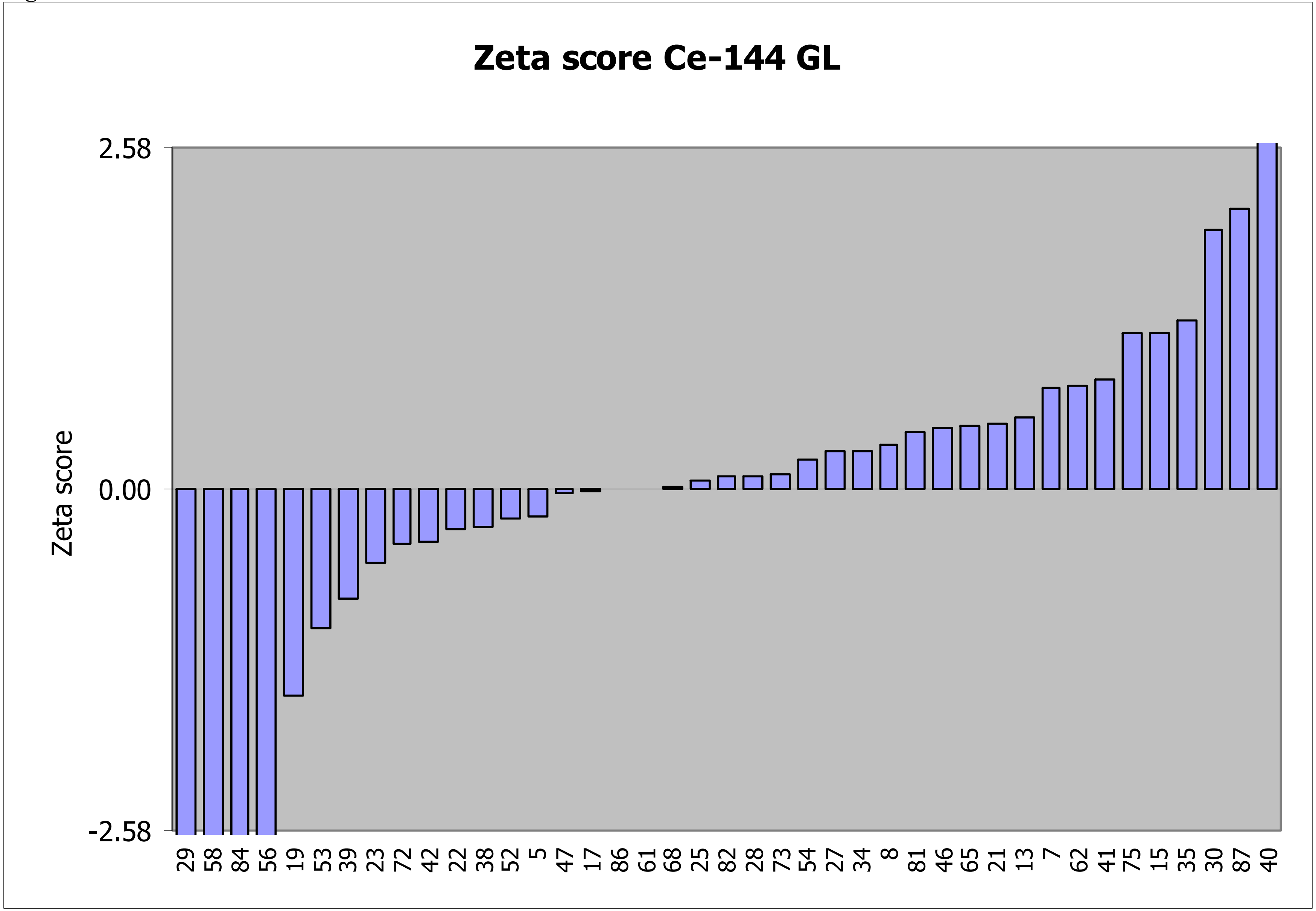


Figure 43C – Relative uncertainty Ce-144 GL

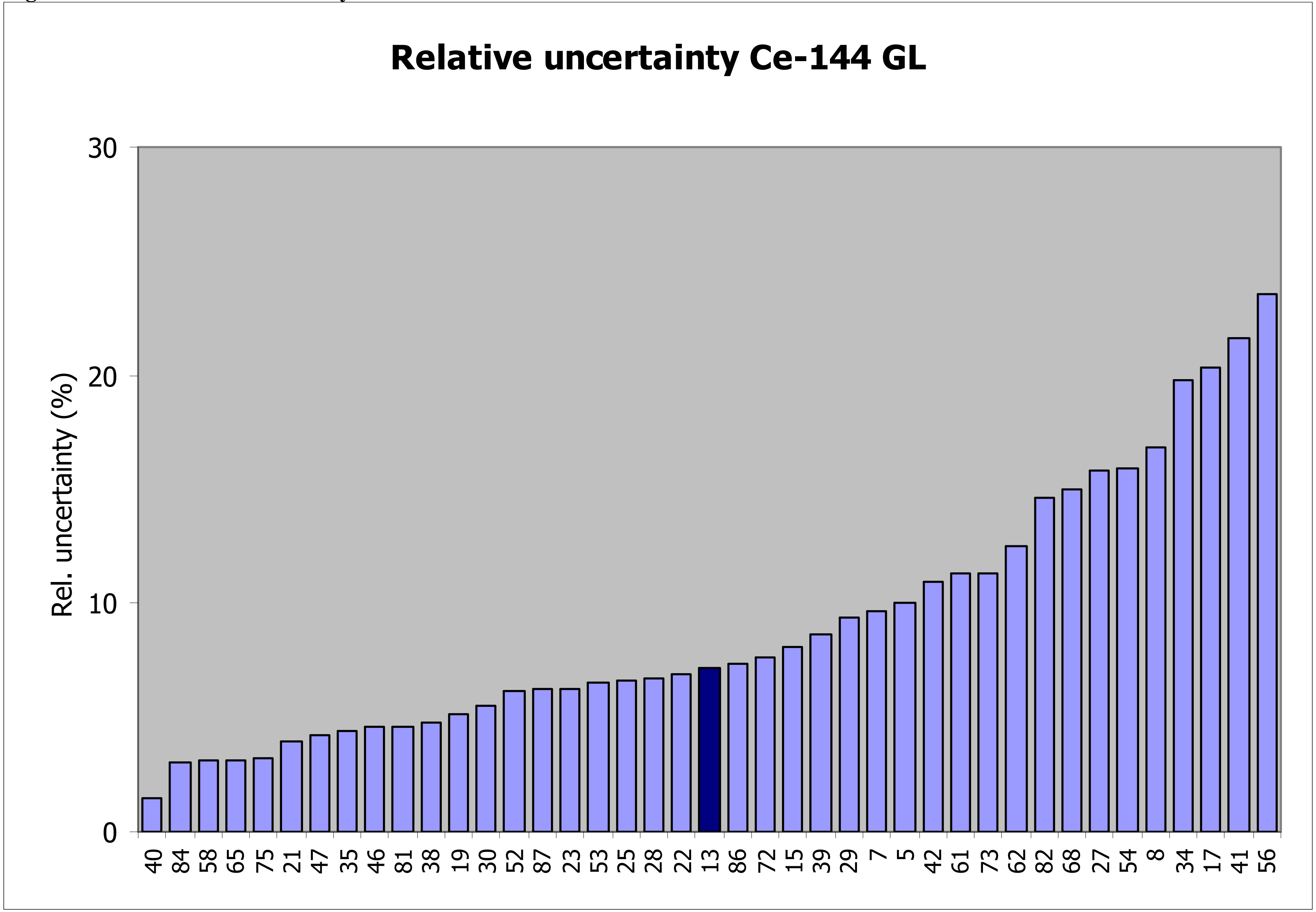


Figure 43D – Kiri plot Ce-144 GL

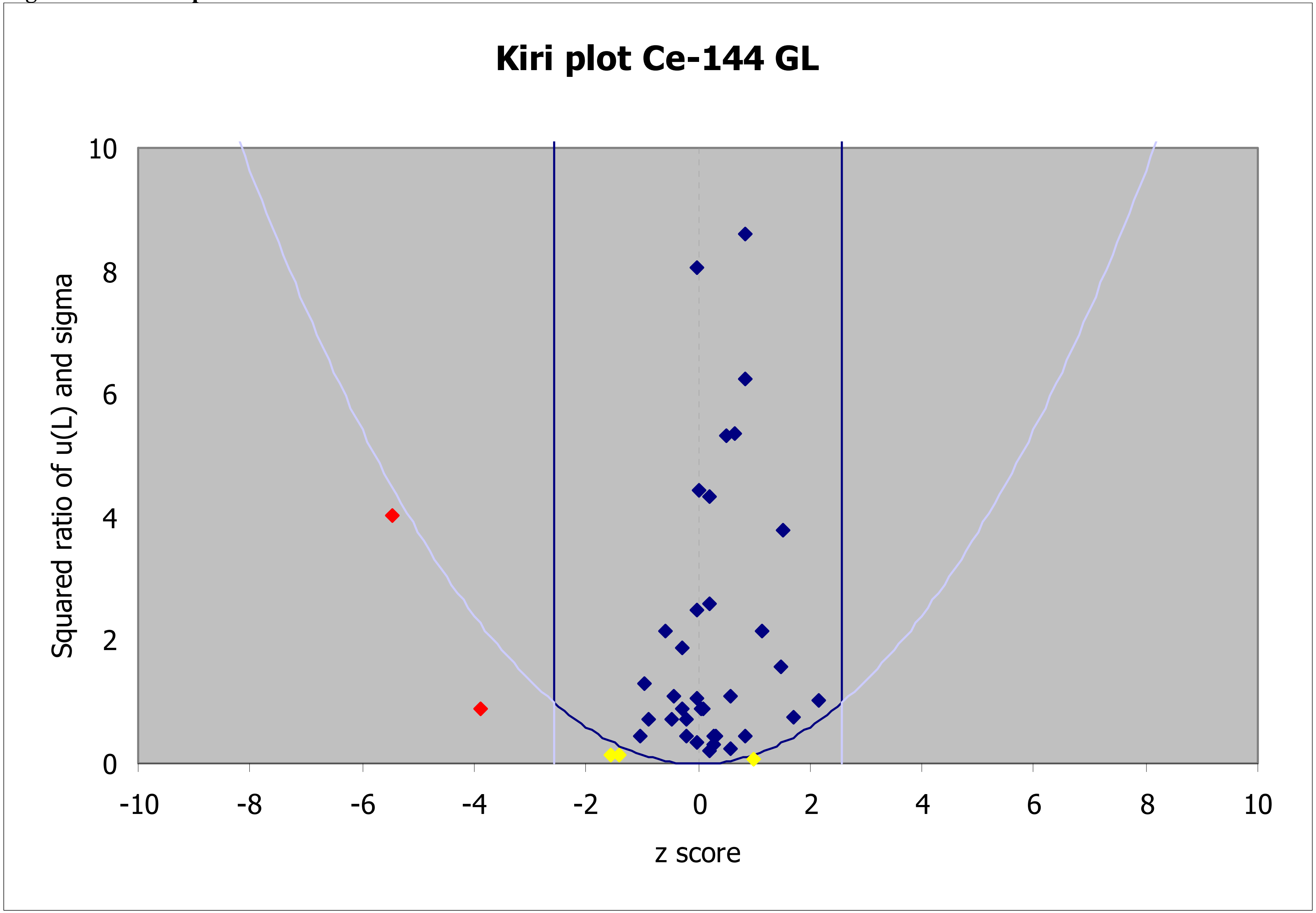


Figure 44A – Deviation Eu-152 GL

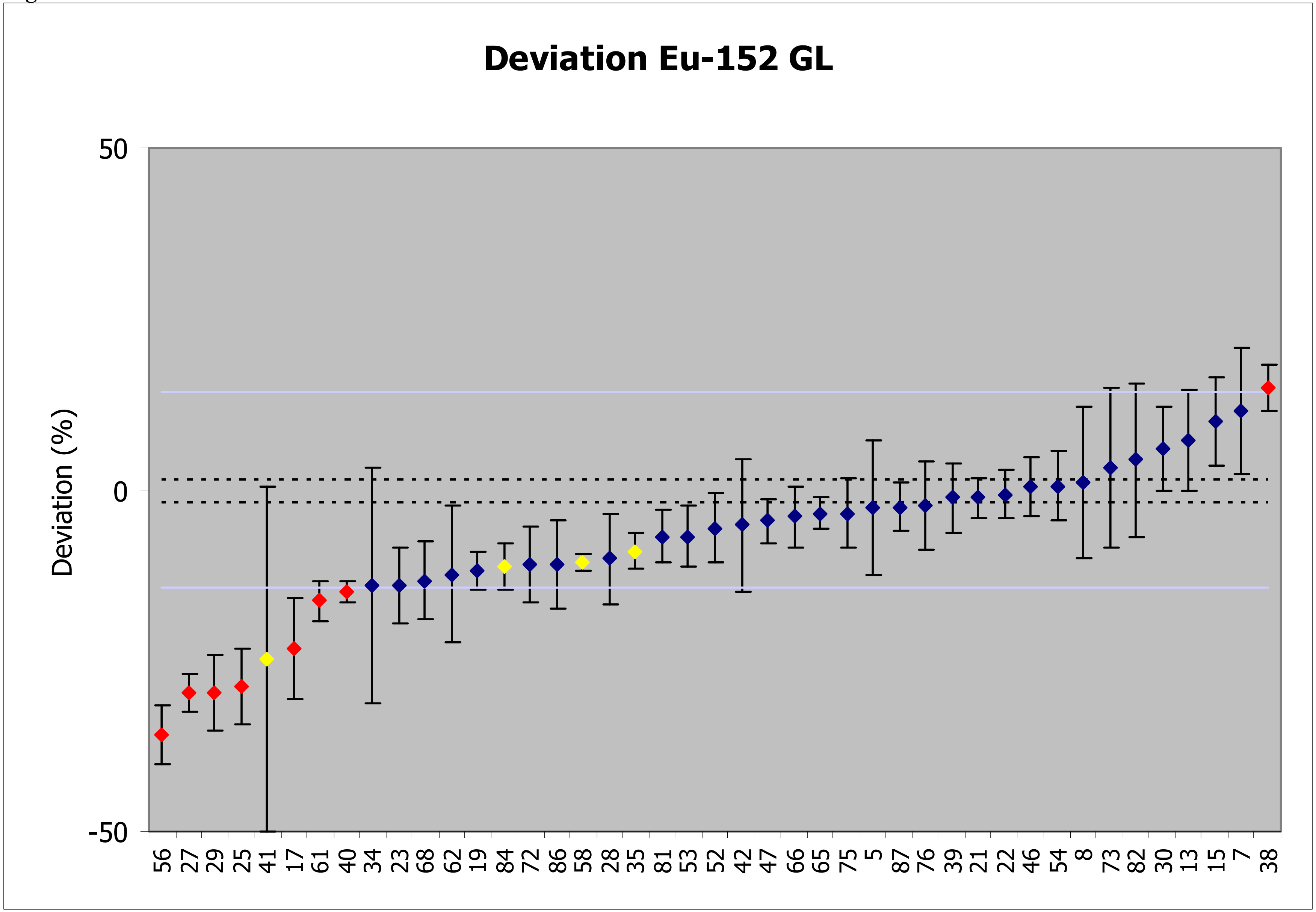


Figure 44B – Zeta score Eu-152 GL

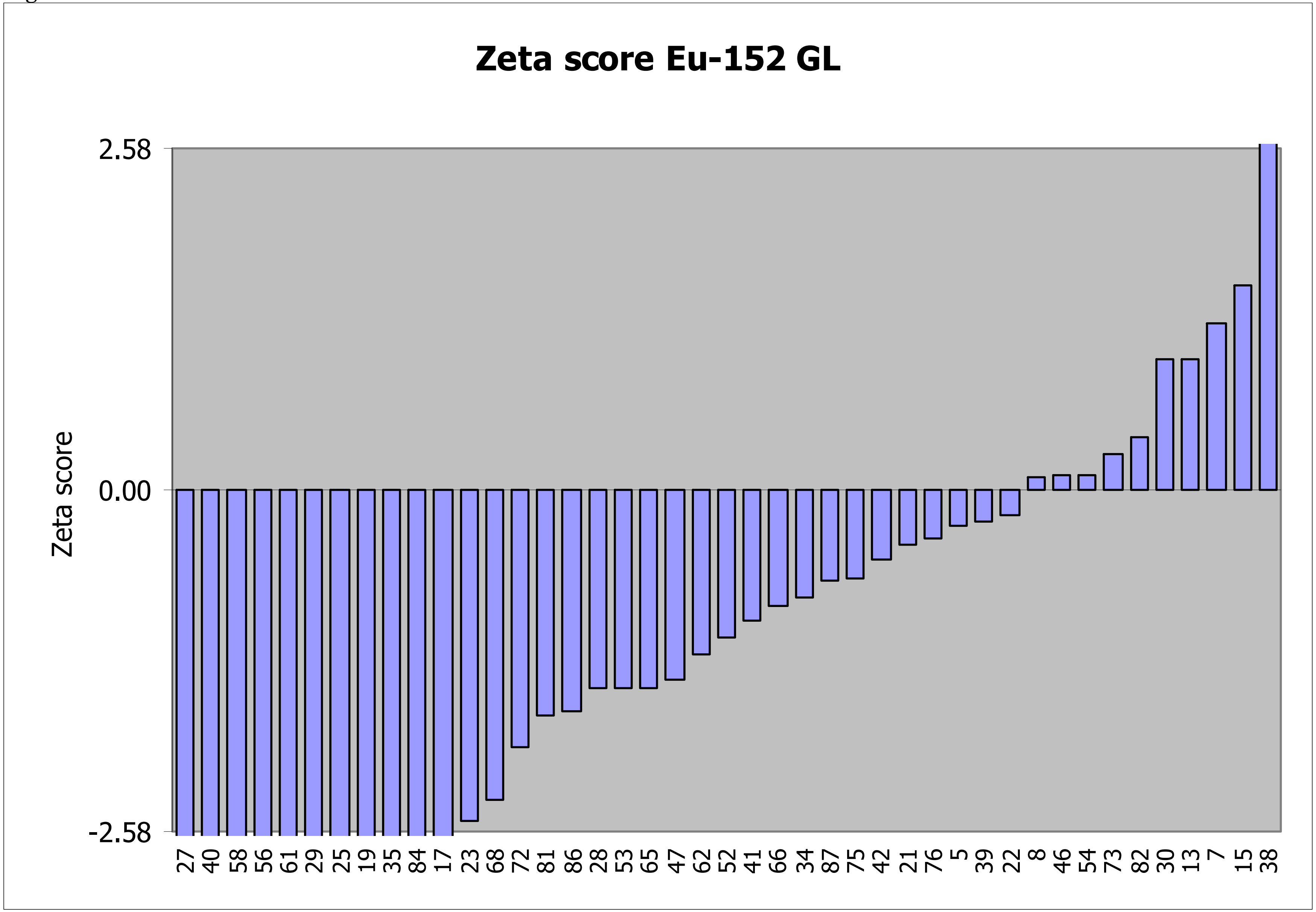


Figure 44C – Relative uncertainty Eu-152 GL

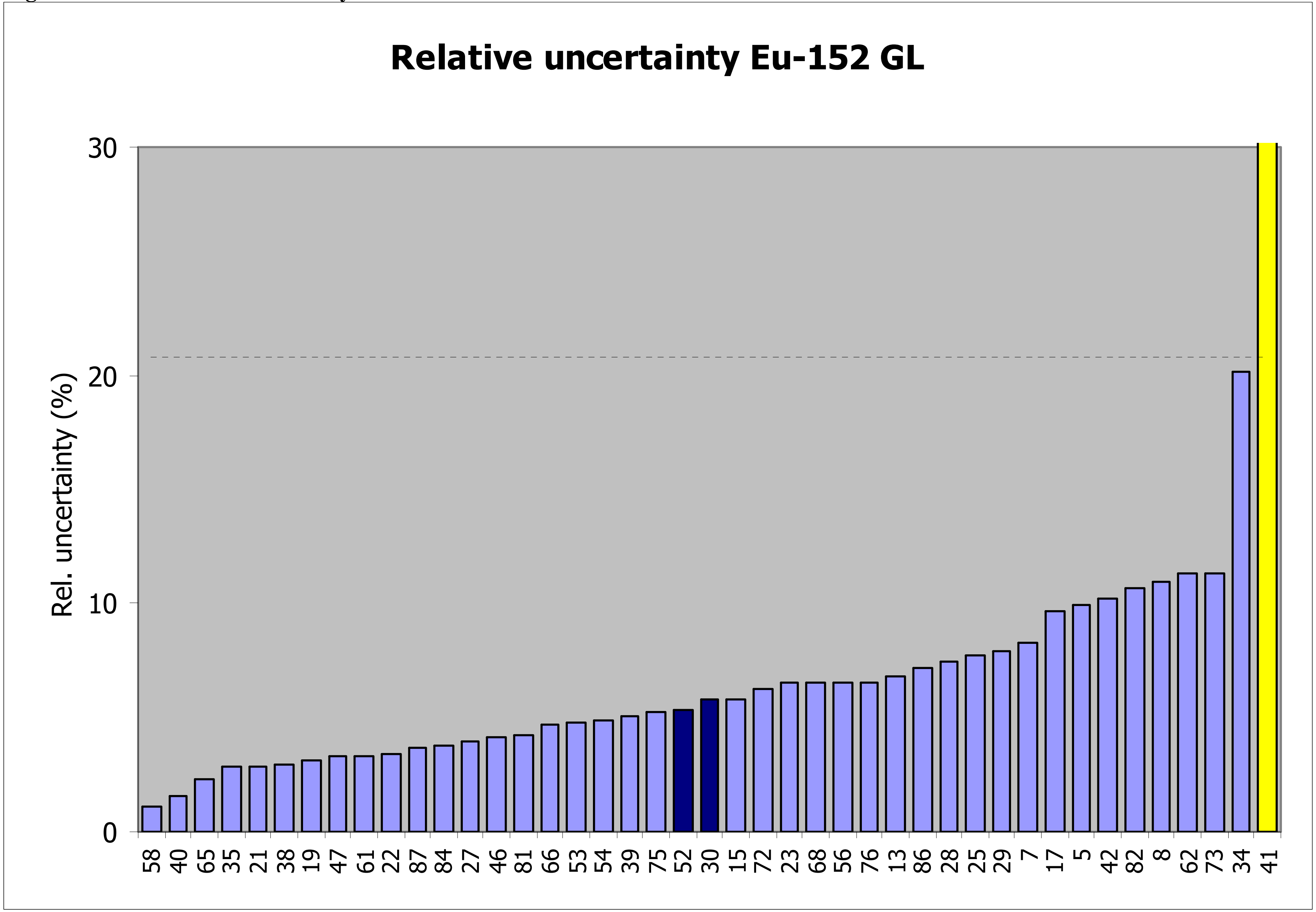


Figure 44D – Kiri plot Eu-152 GL

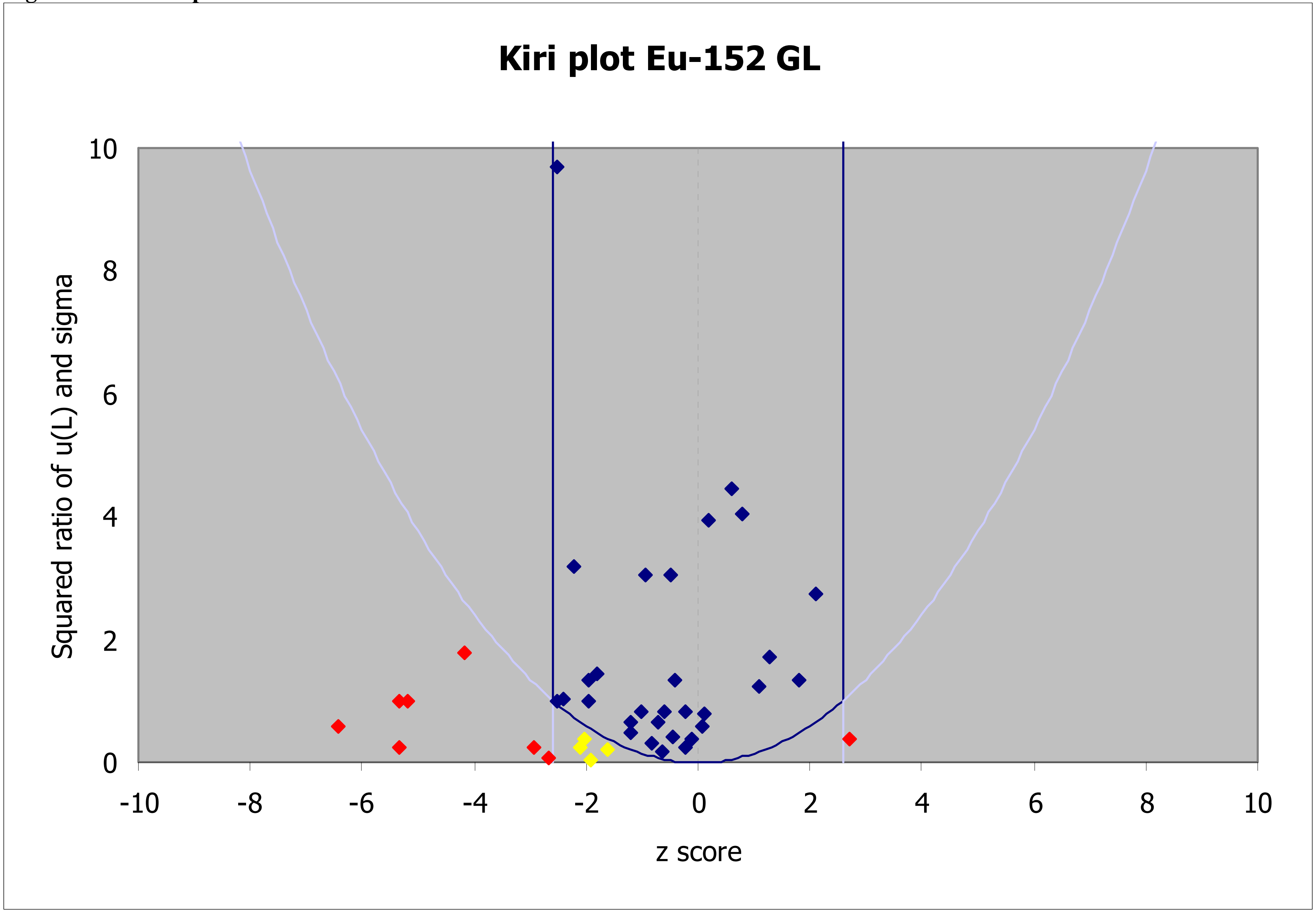


Figure 45A – Deviation Eu-155 GL

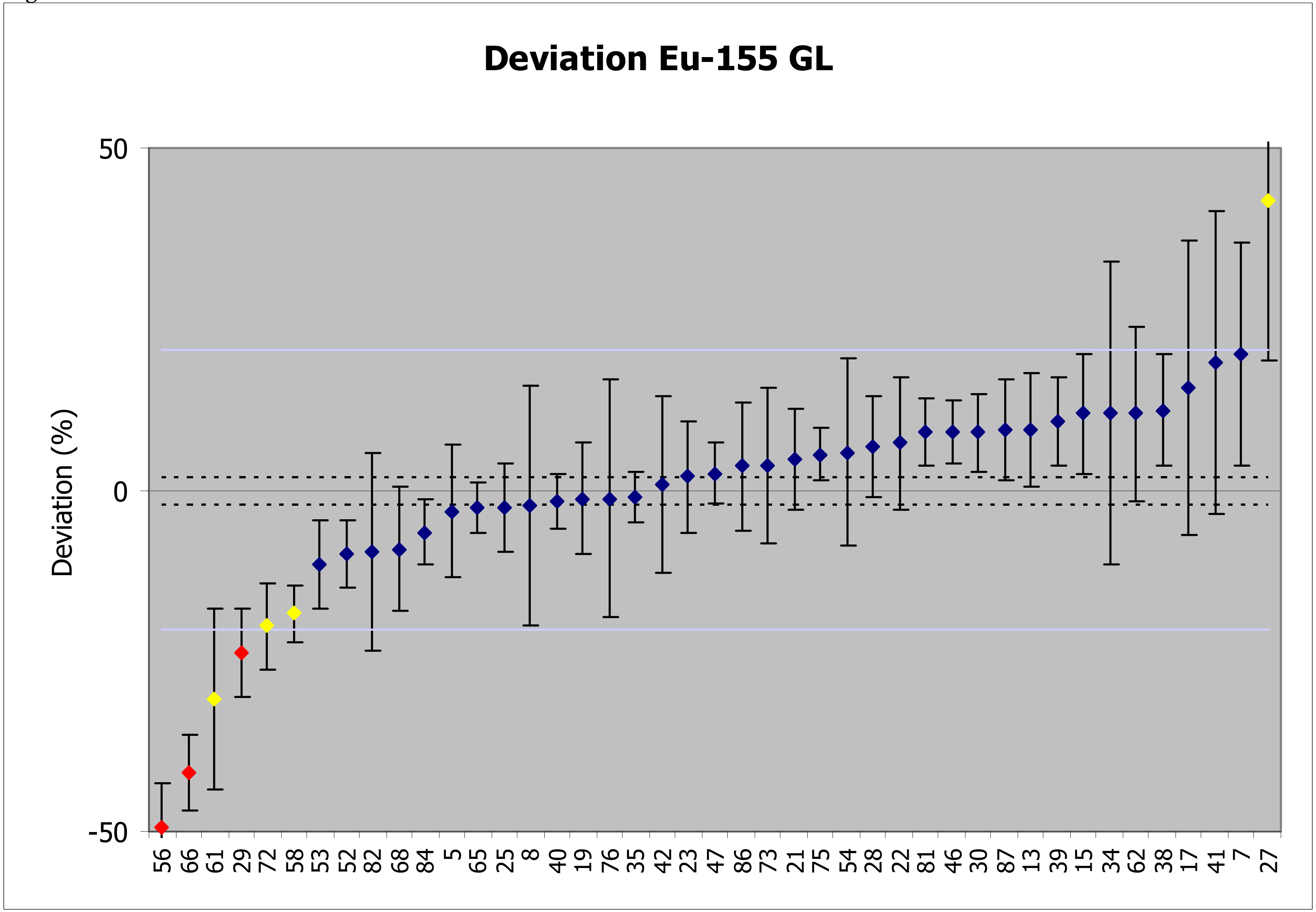


Figure 45B – Zeta score Eu-155 GL

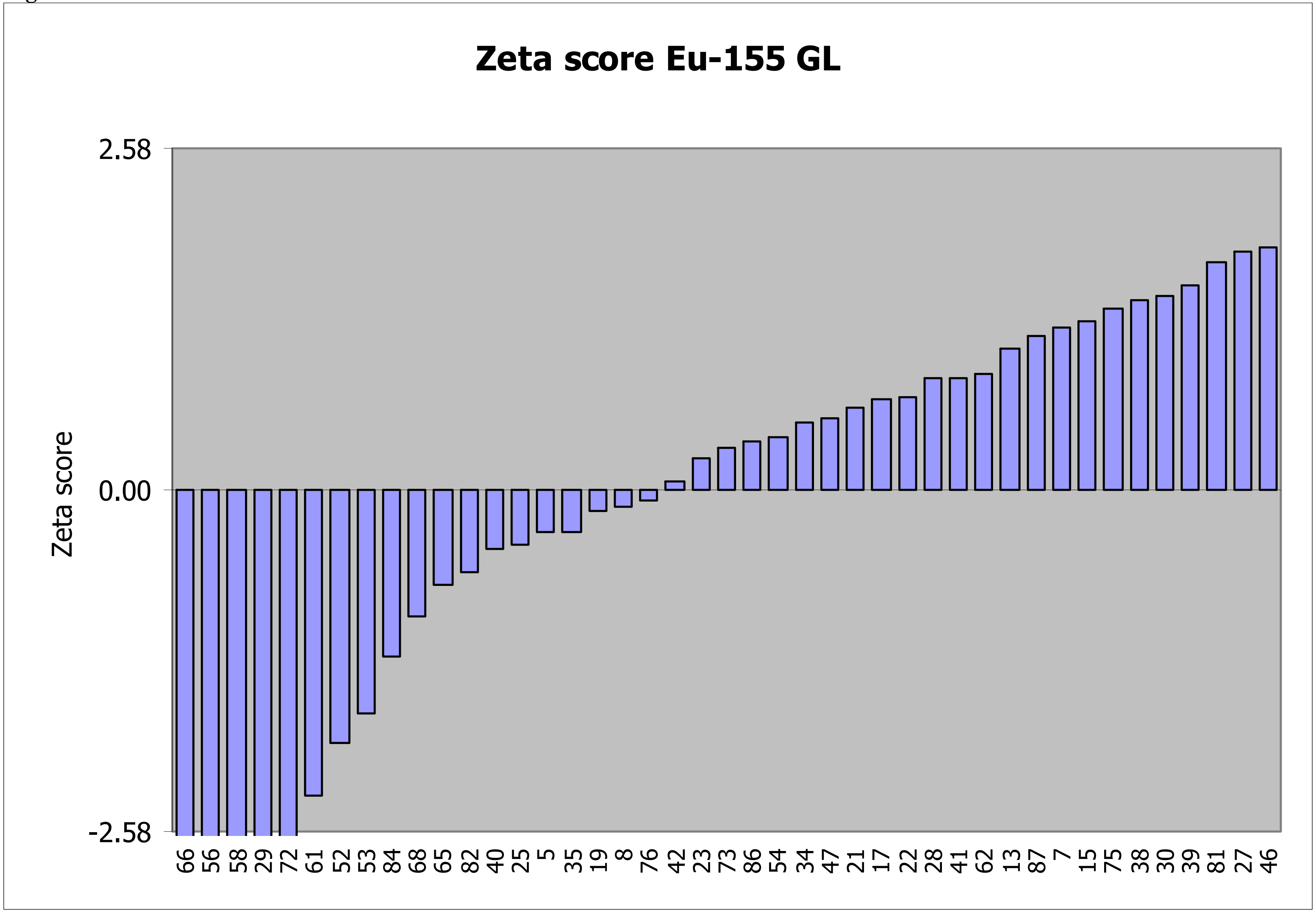


Figure 45C – Relative uncertainty Eu-155 GL

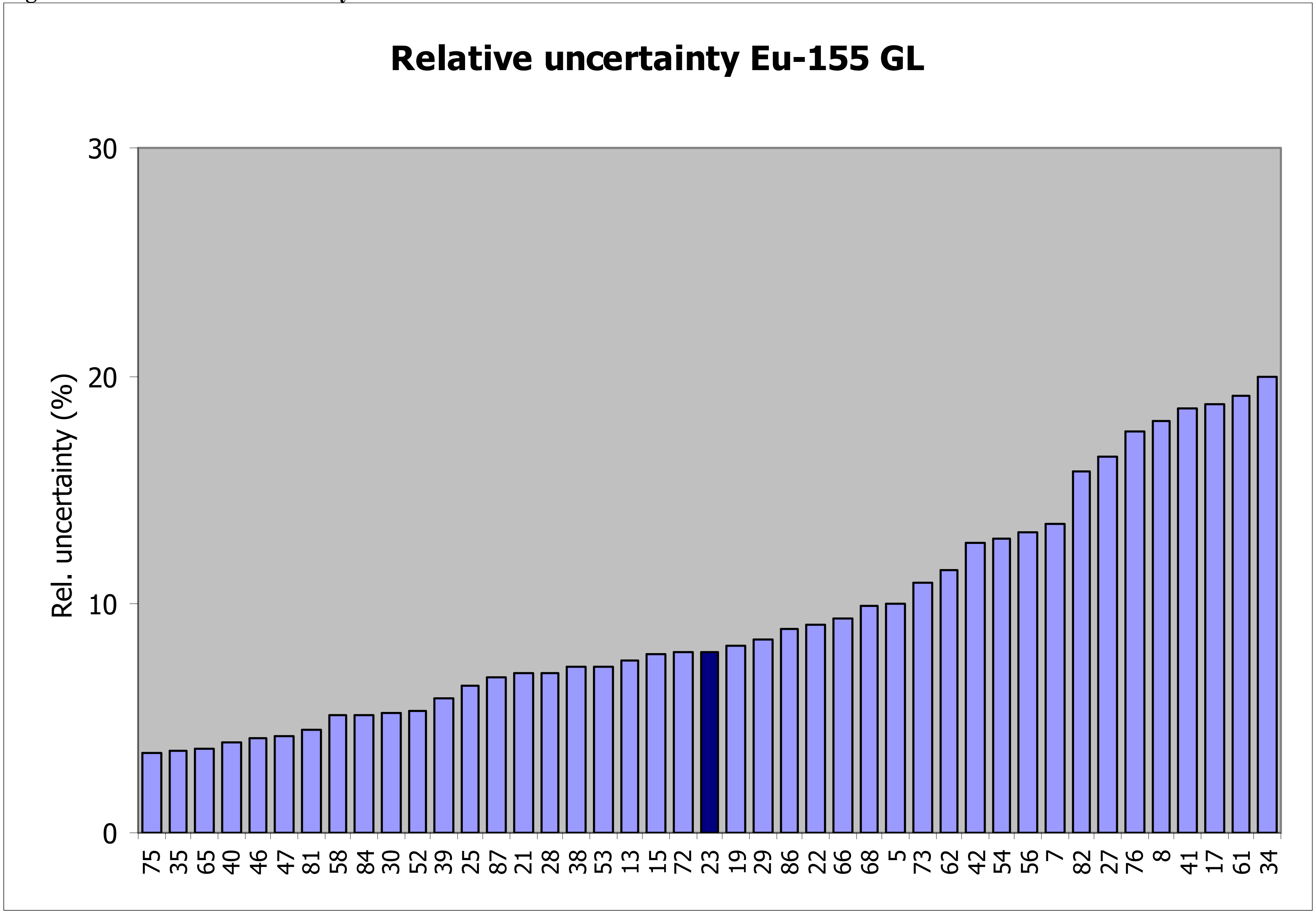


Figure 45D – Kiri plot Eu-155 GL

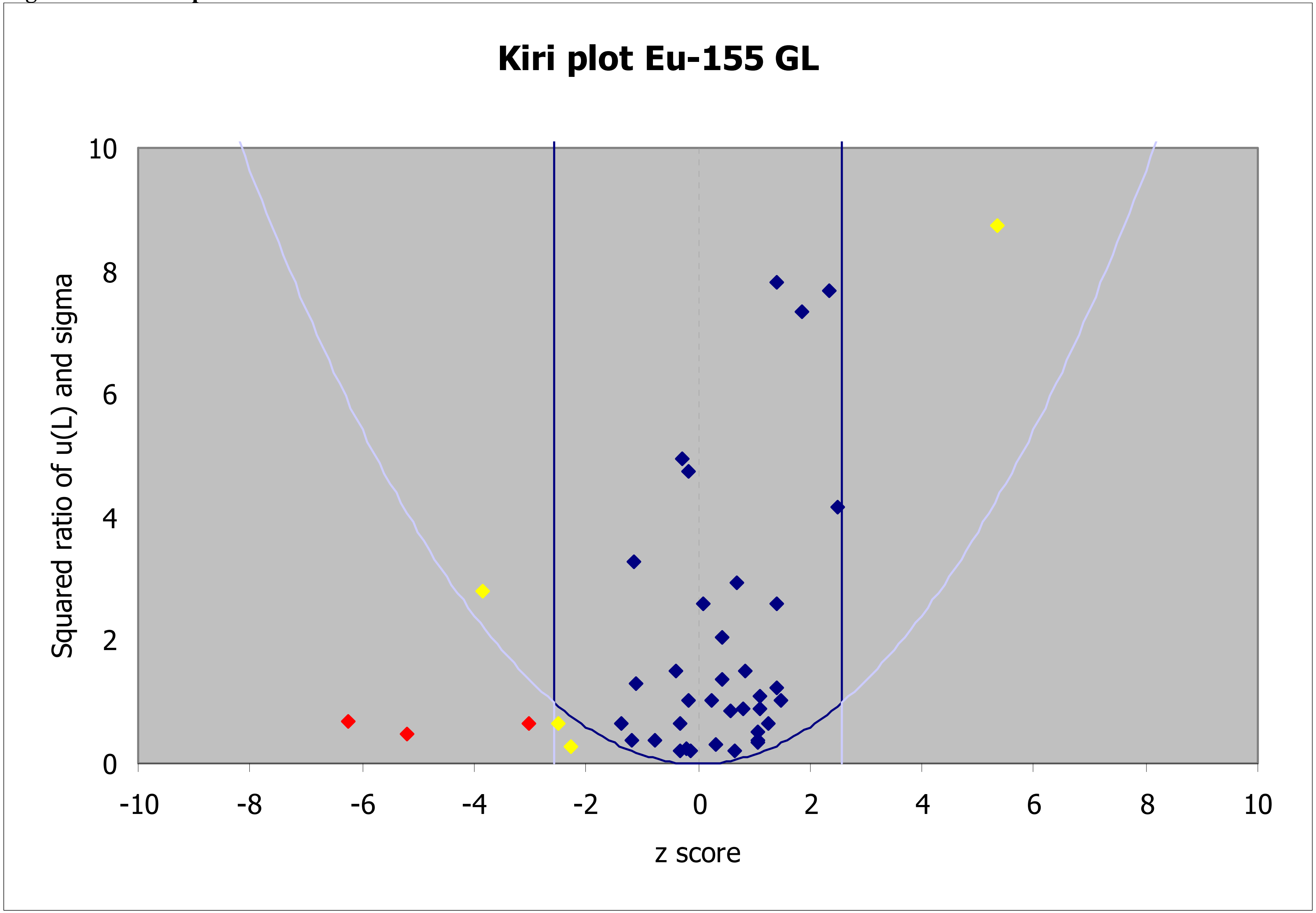


Figure 46A – Deviation Co-60 GH

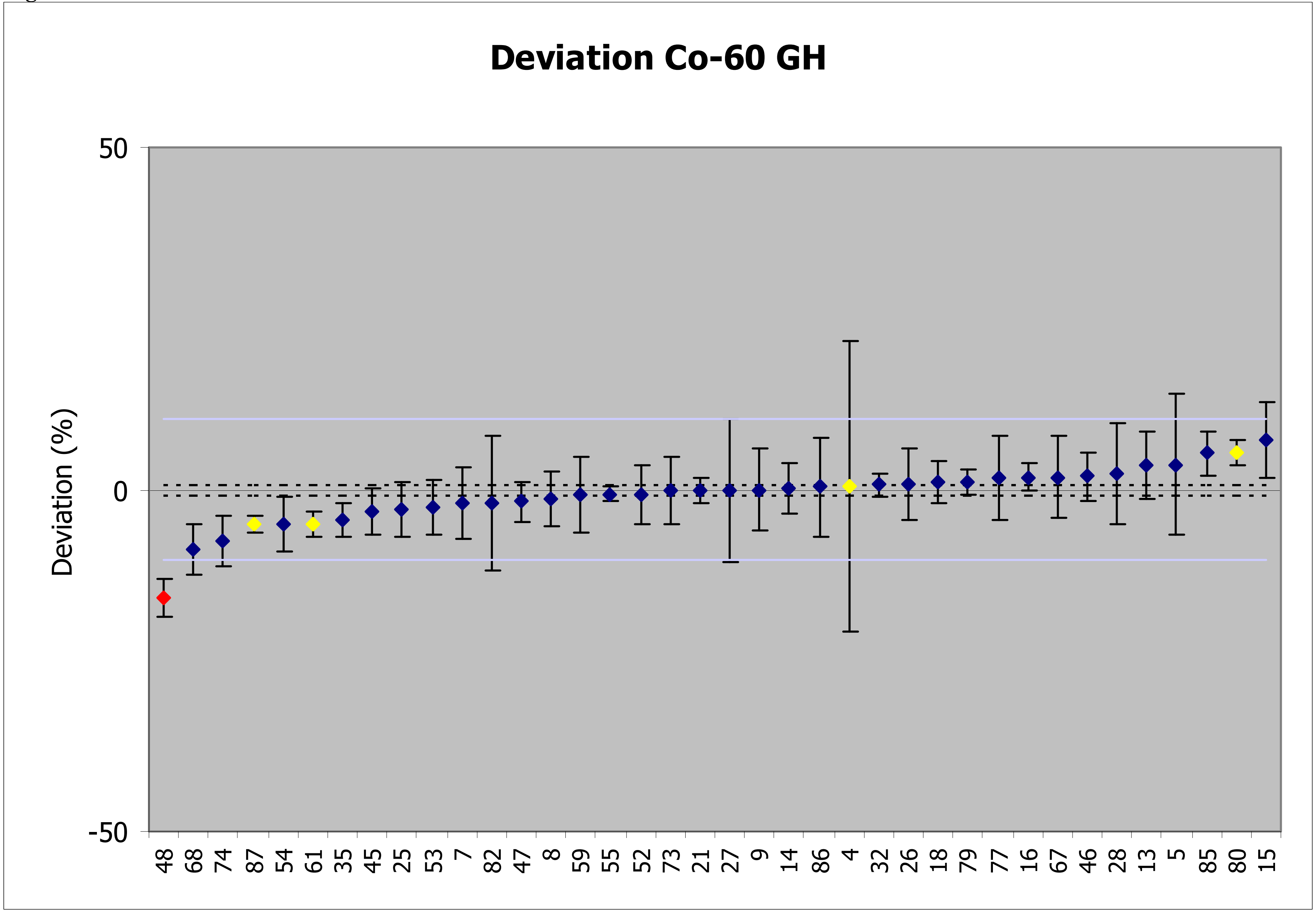


Figure 46B – Zeta score Co-60 GH

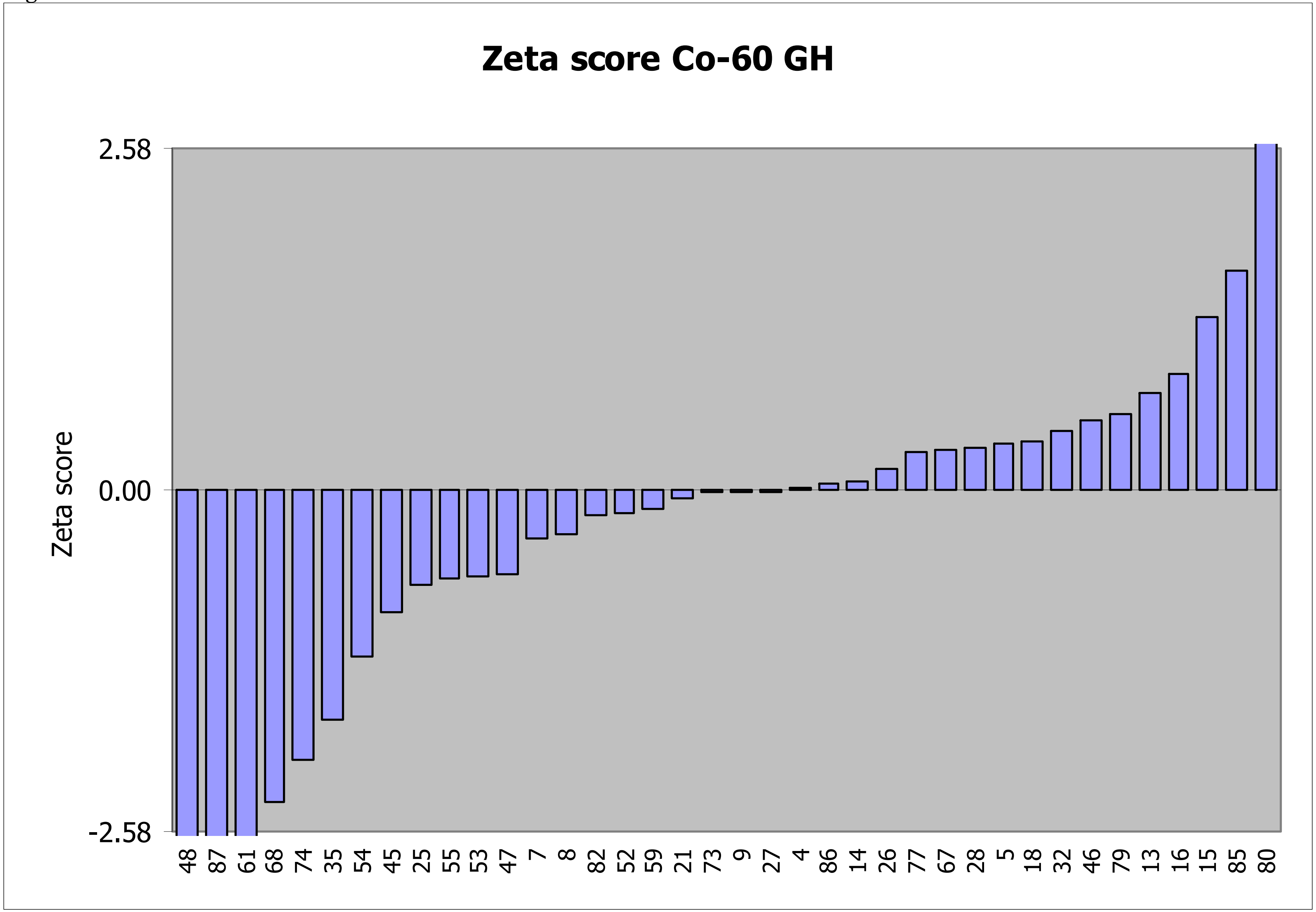


Figure 46C – Relative uncertainty Co-60 GH

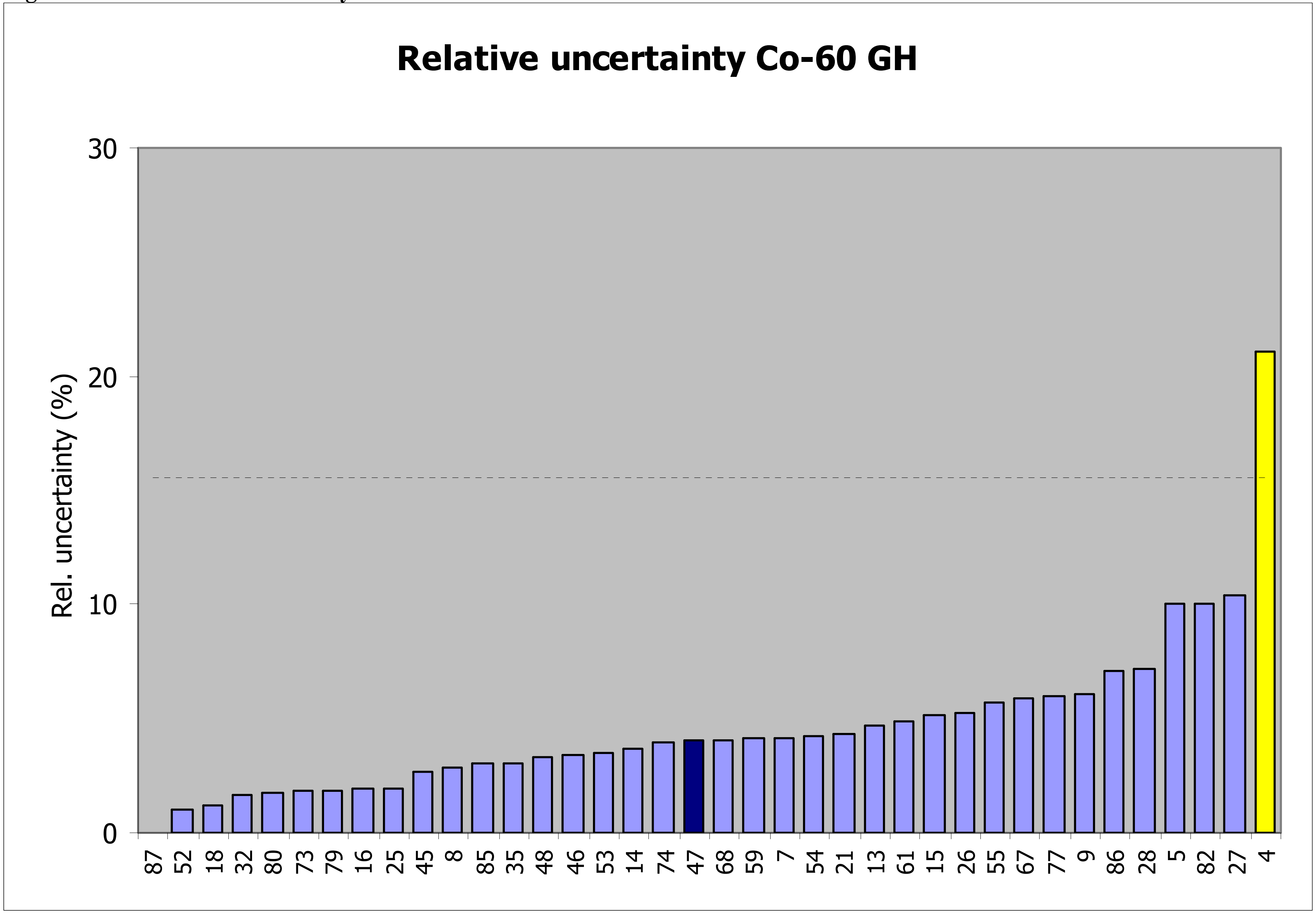


Figure 46D – Kiri plot Co-60 GH

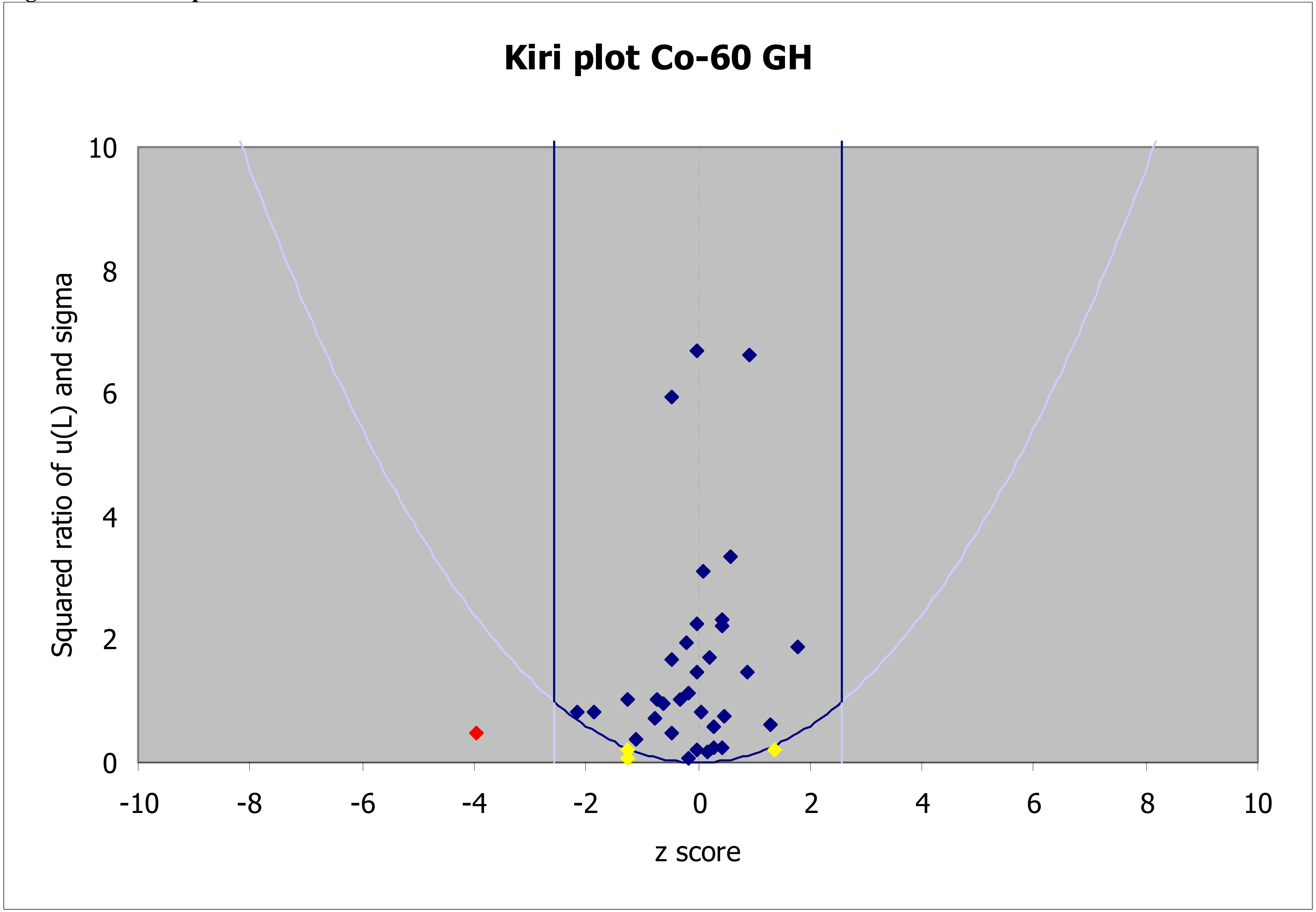


Figure 47A – Deviation Zr-95 GH

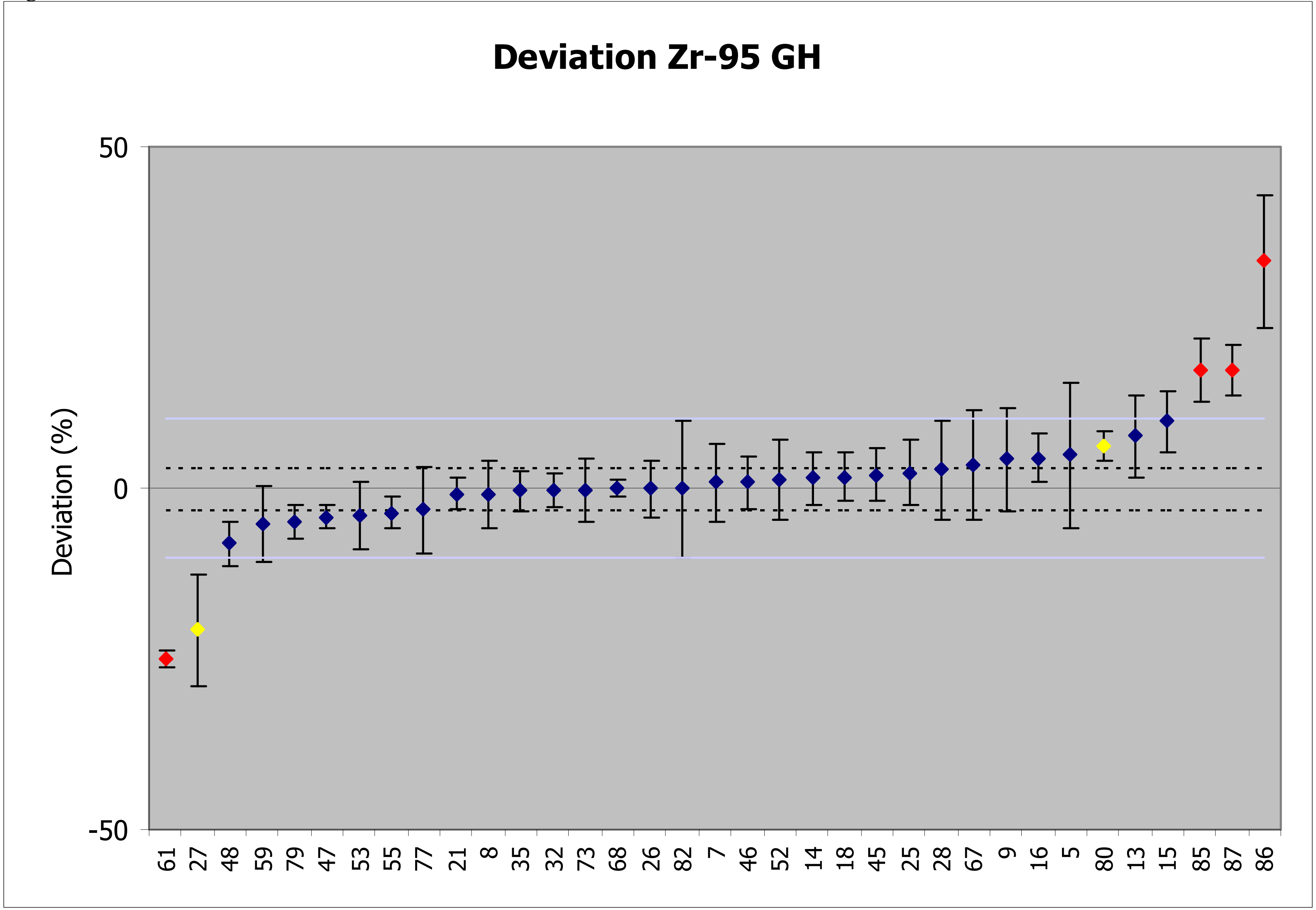


Figure 47B – Zeta score Zr-95 GH

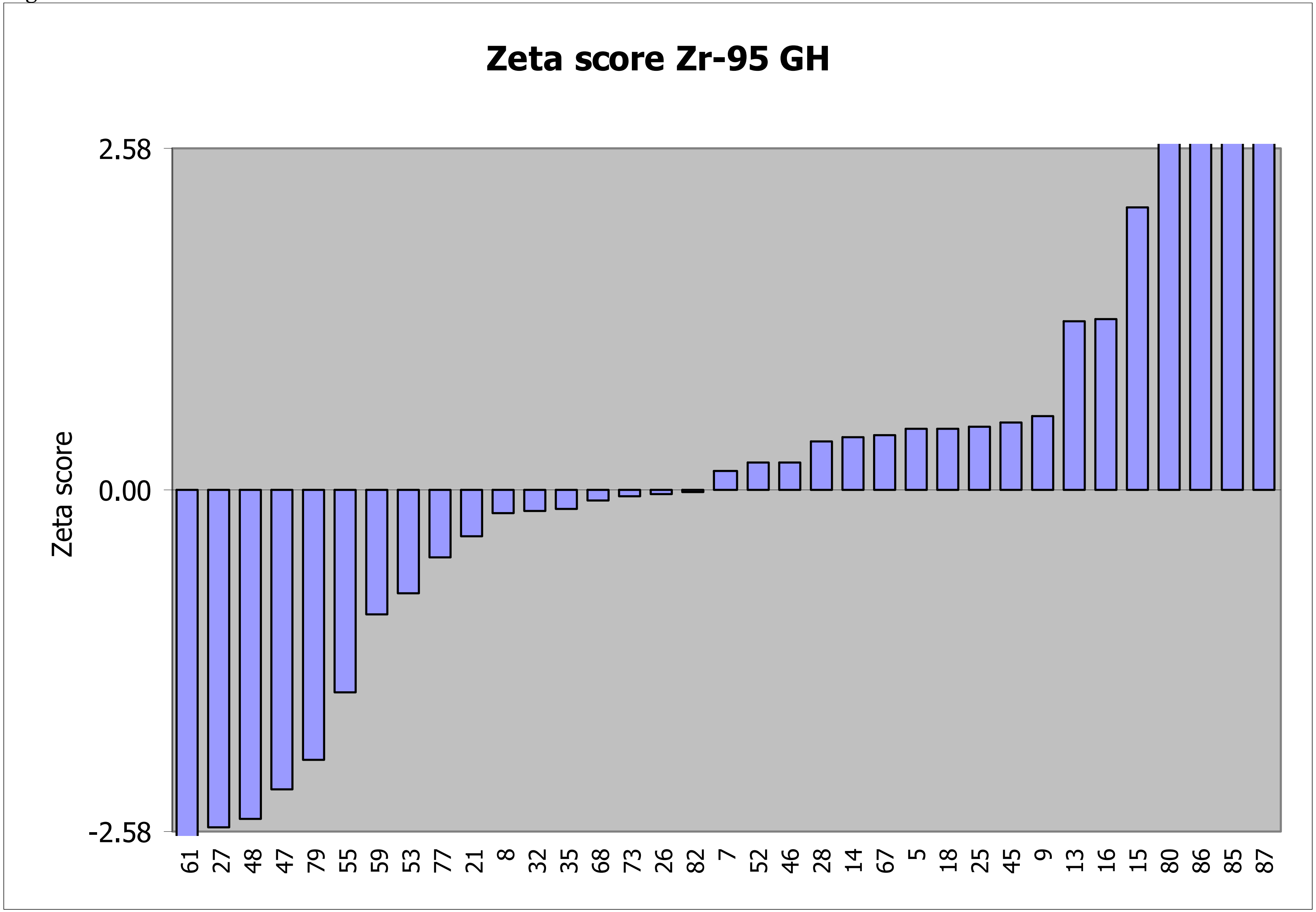


Figure 47C – Relative uncertainty Zr-95 GH

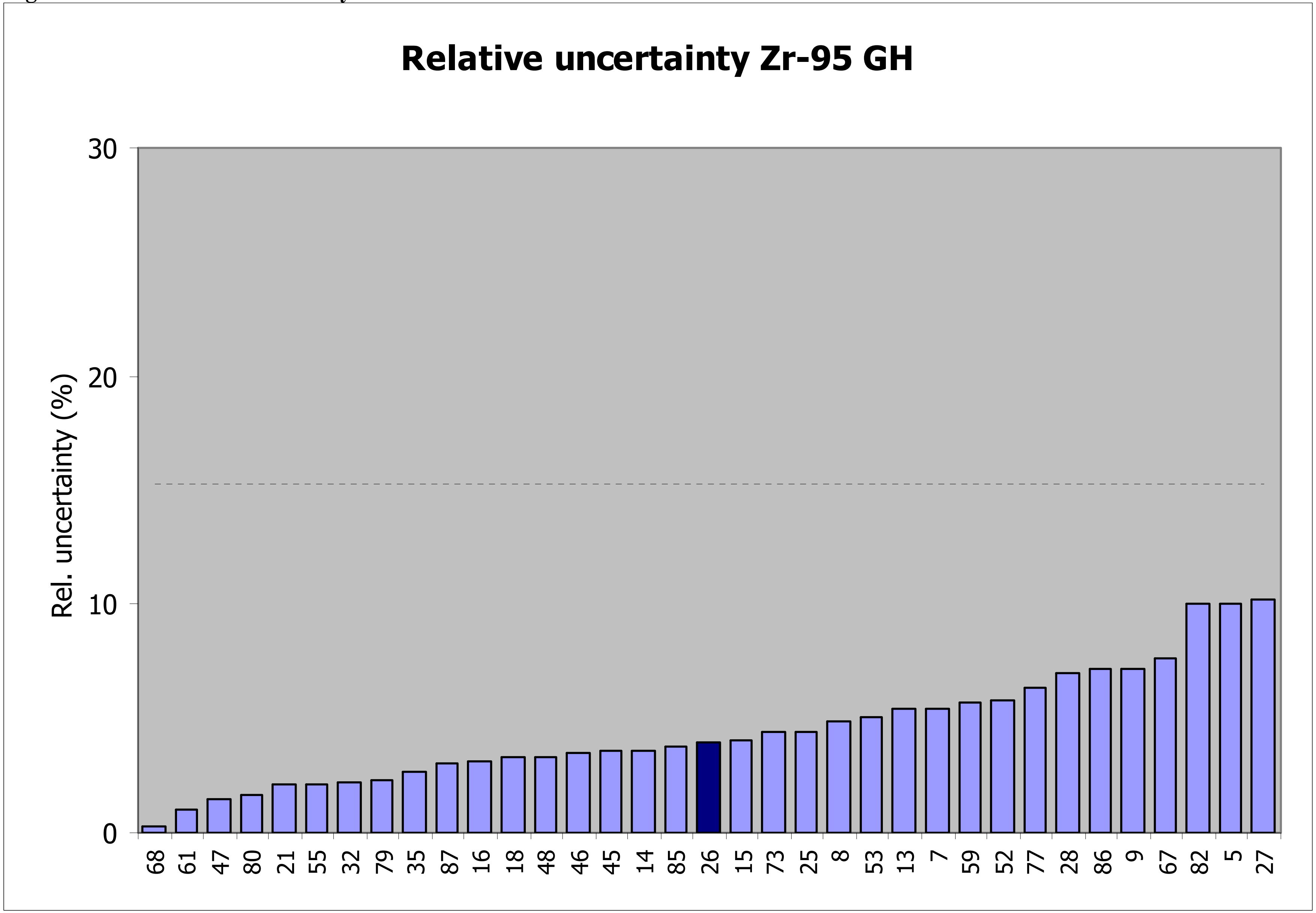


Figure 47D – Kiri plot Zr-95 GH

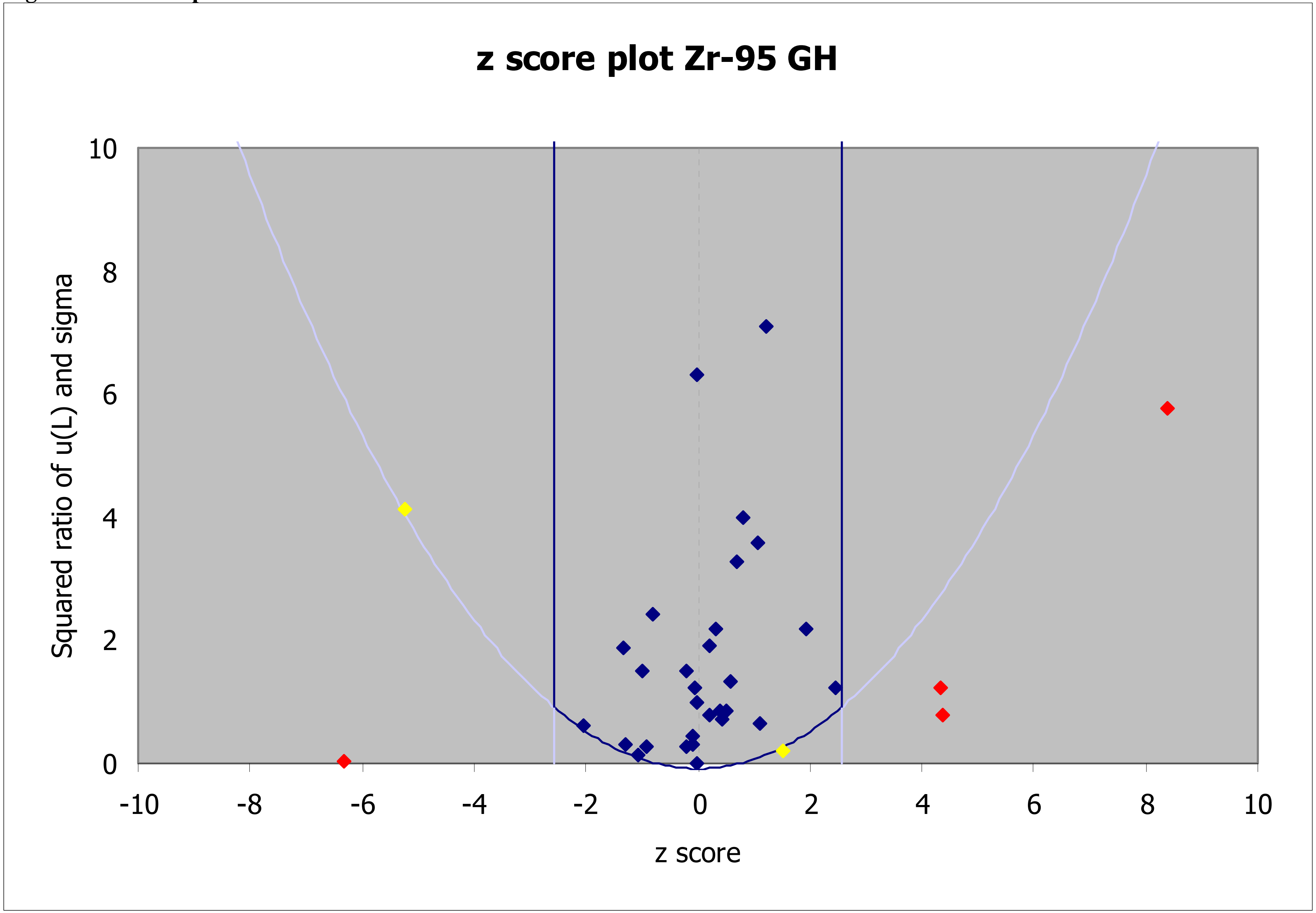


Figure 48A – Deviation Nb-95 GH

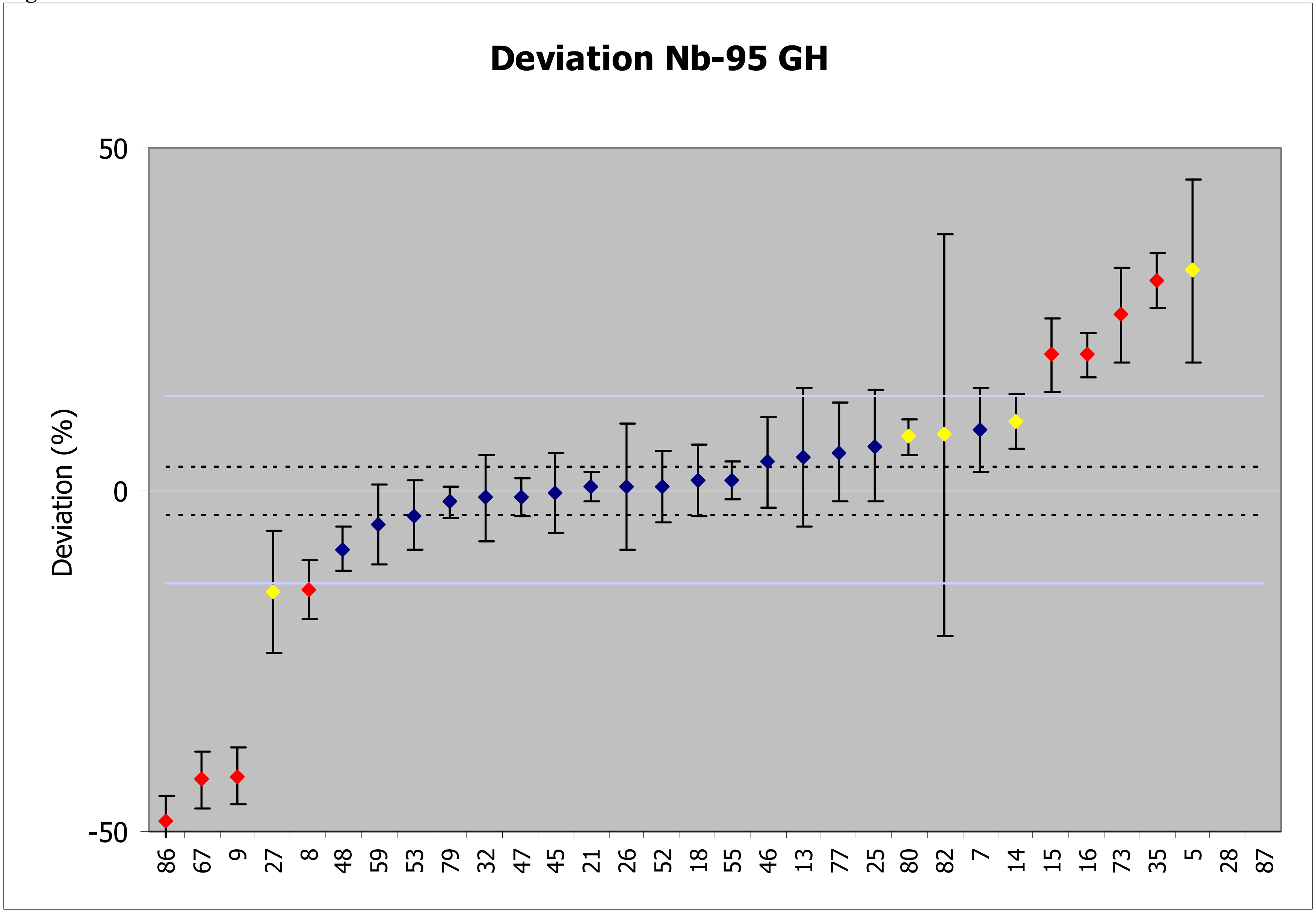


Figure 48B – Zeta score Nb-95 GH

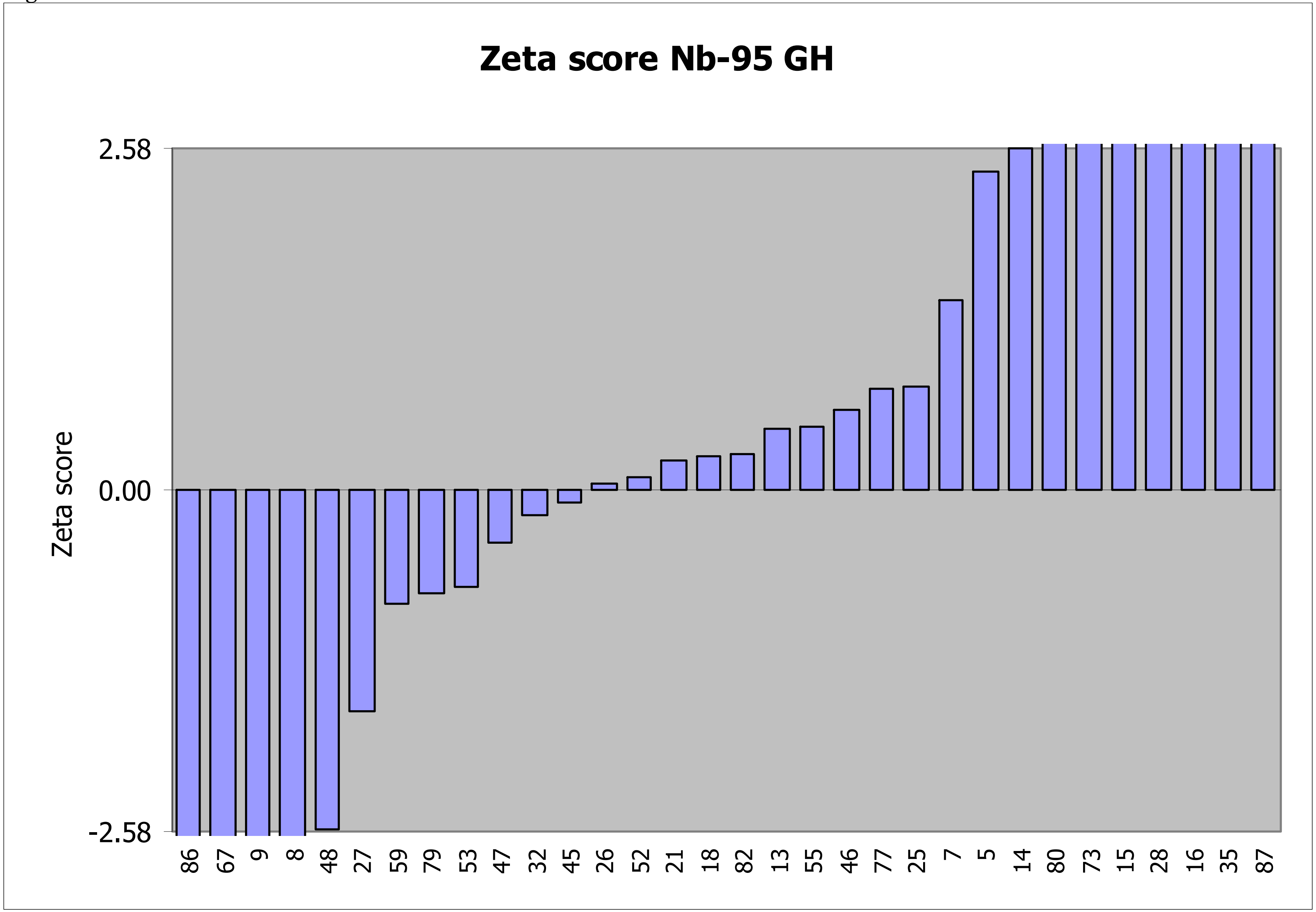


Figure 48C – Relative uncertainty Nb-95 GH

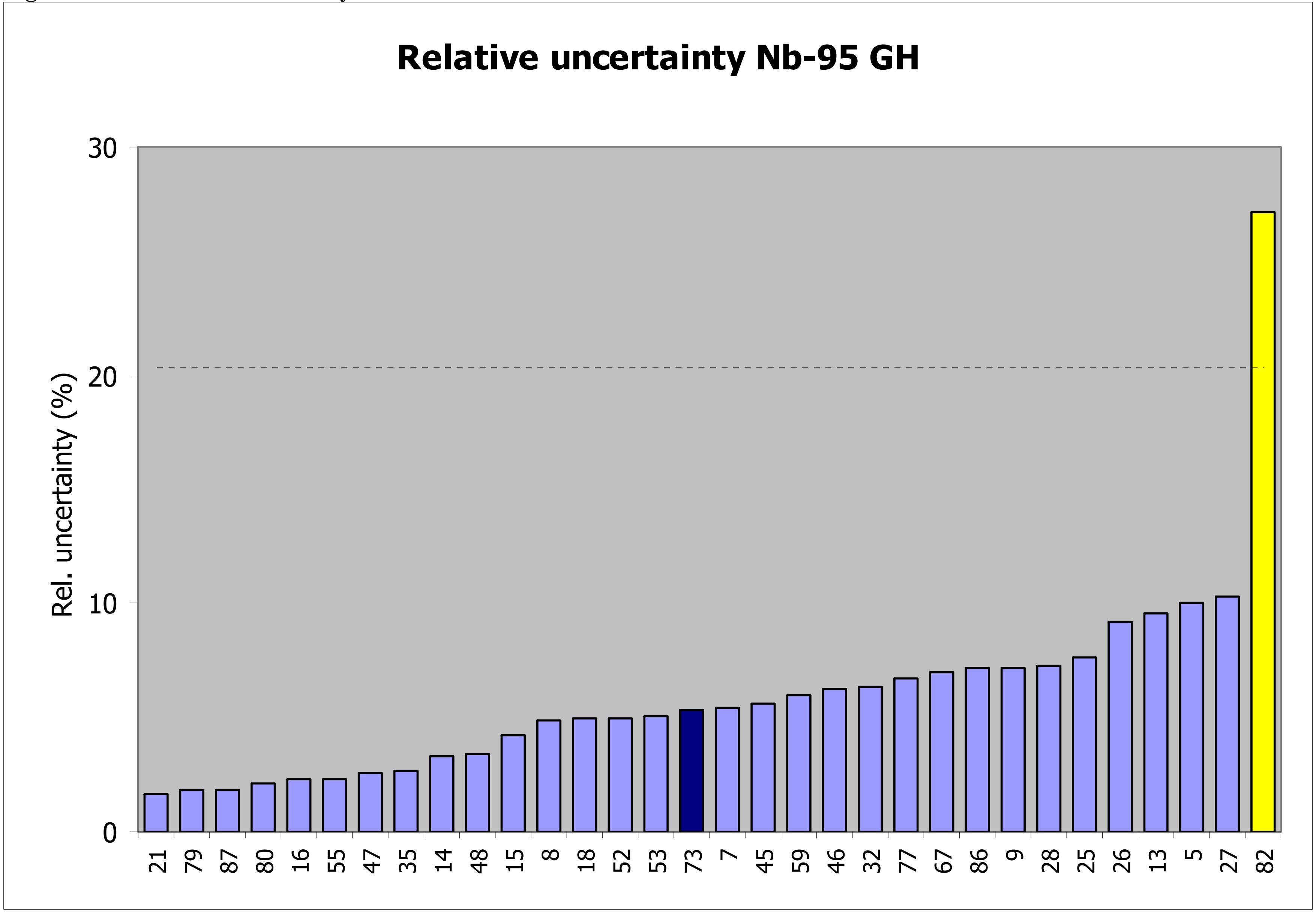


Figure 48D – Kiri plot Nb-95 GH

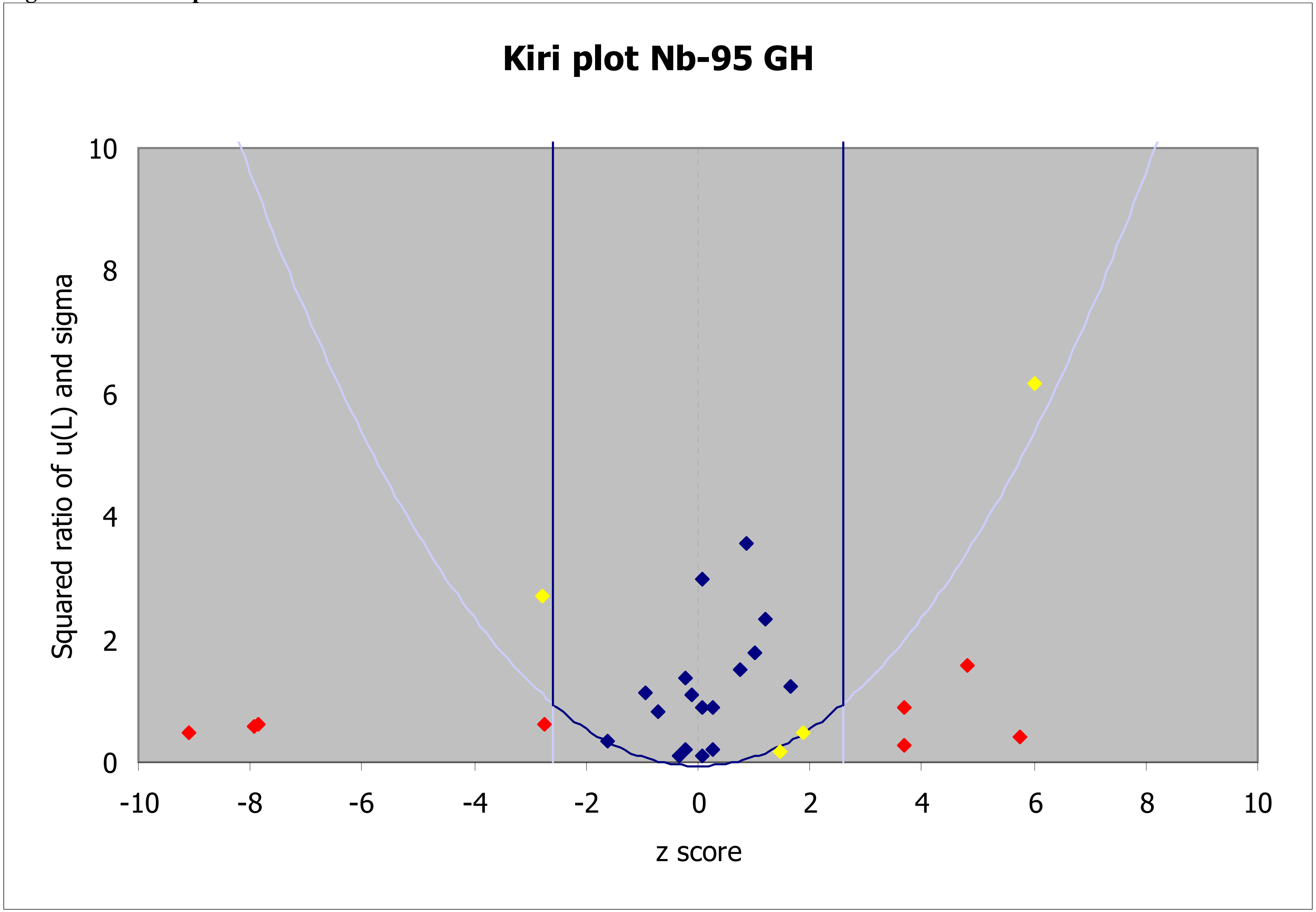


Figure 49A – Deviation Sb-125 GH

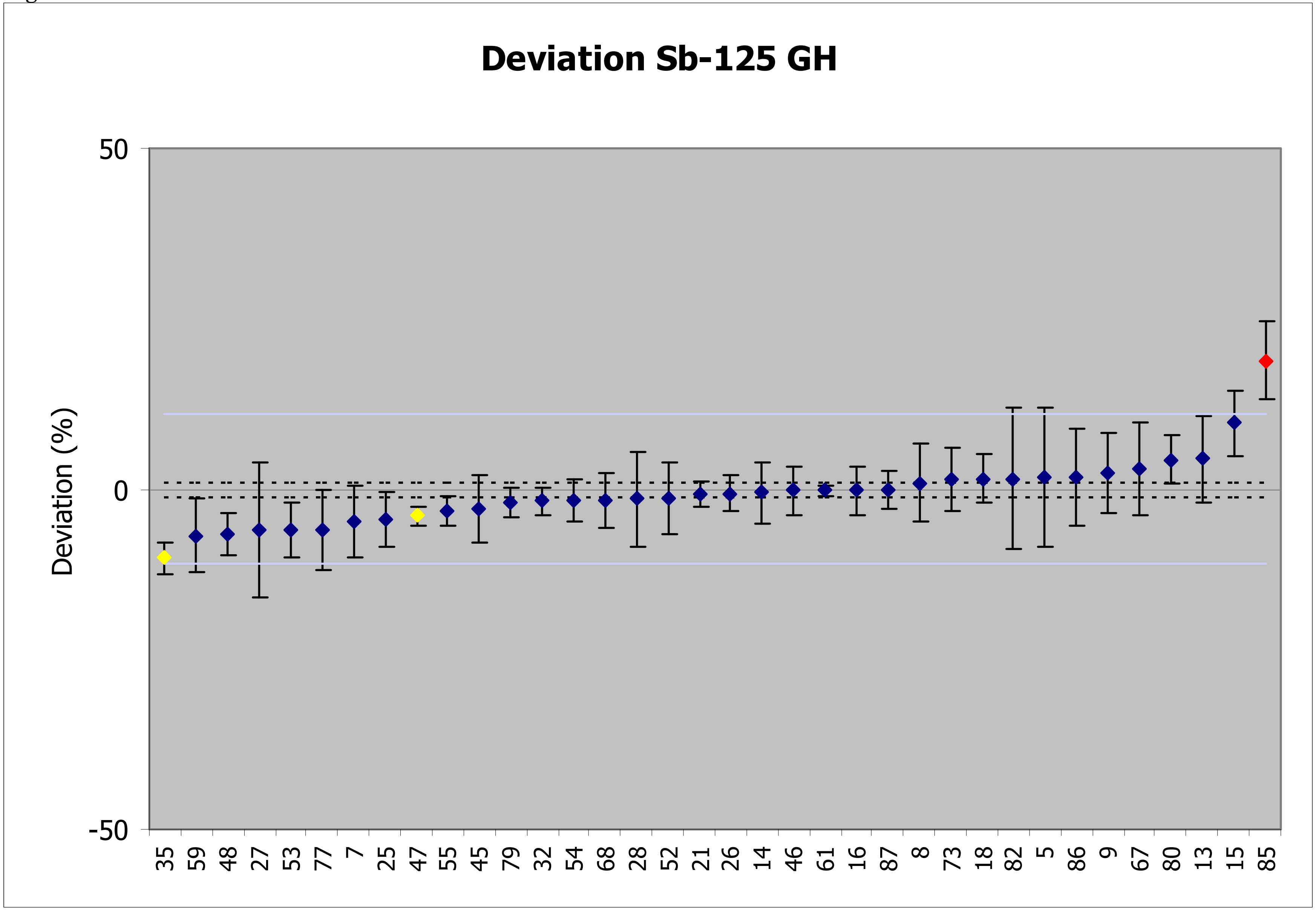


Figure 49B – Zeta score Sb-125 GH

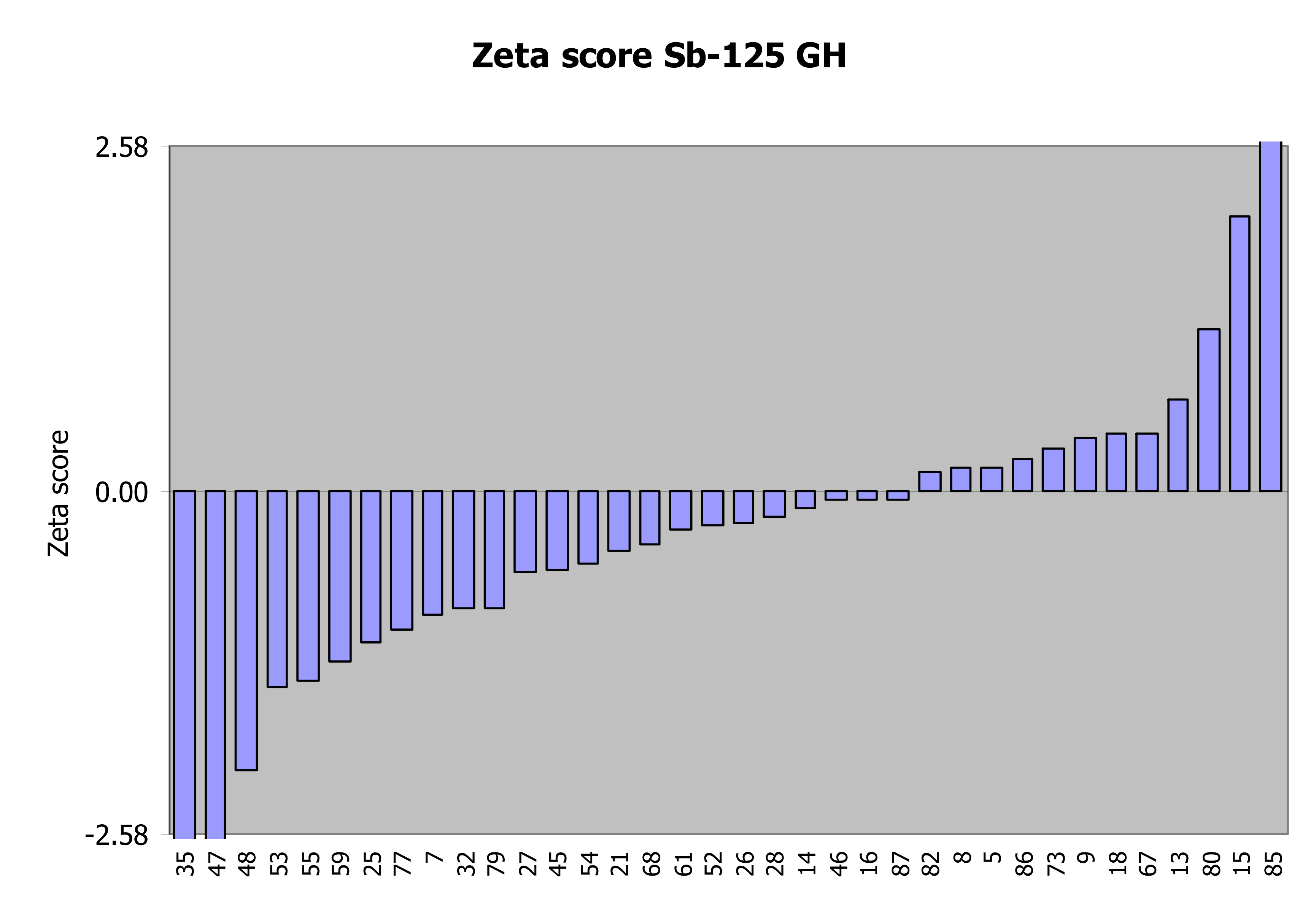


Figure 49C – Relative uncertainty Sb-125 GH

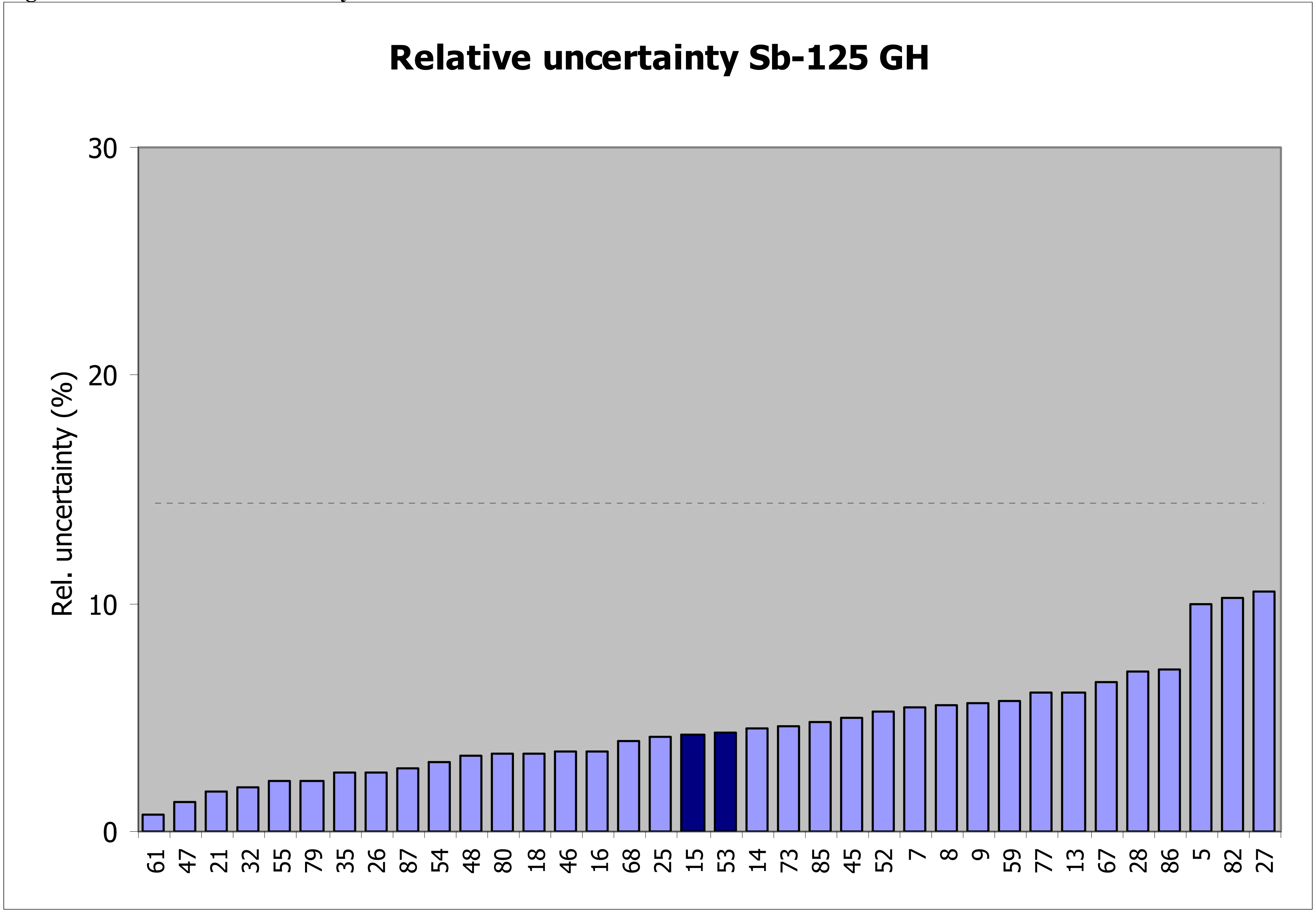


Figure 49D – Kiri plot Sb-125 GH

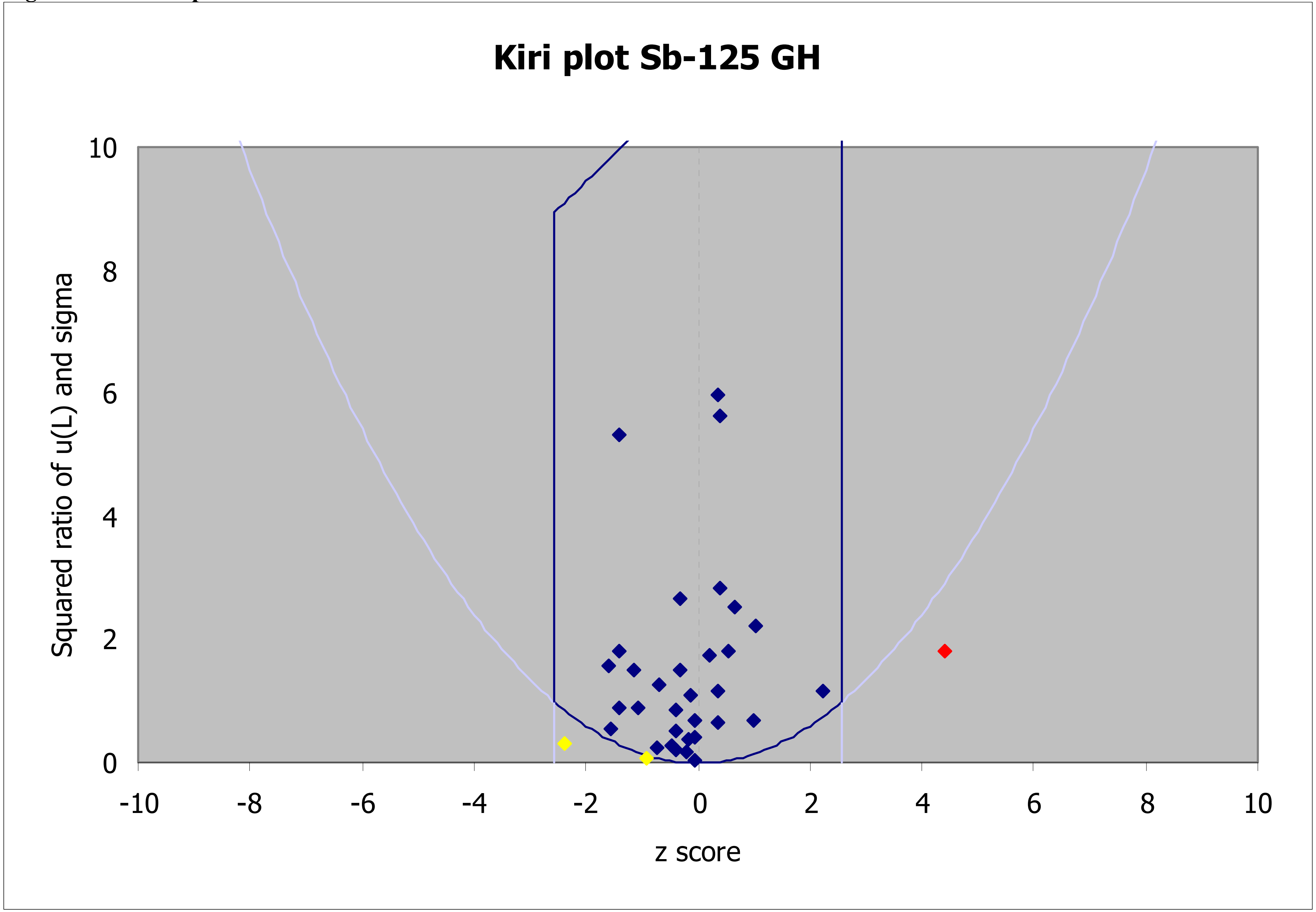


Figure 50A – Deviation Ba-133 GH

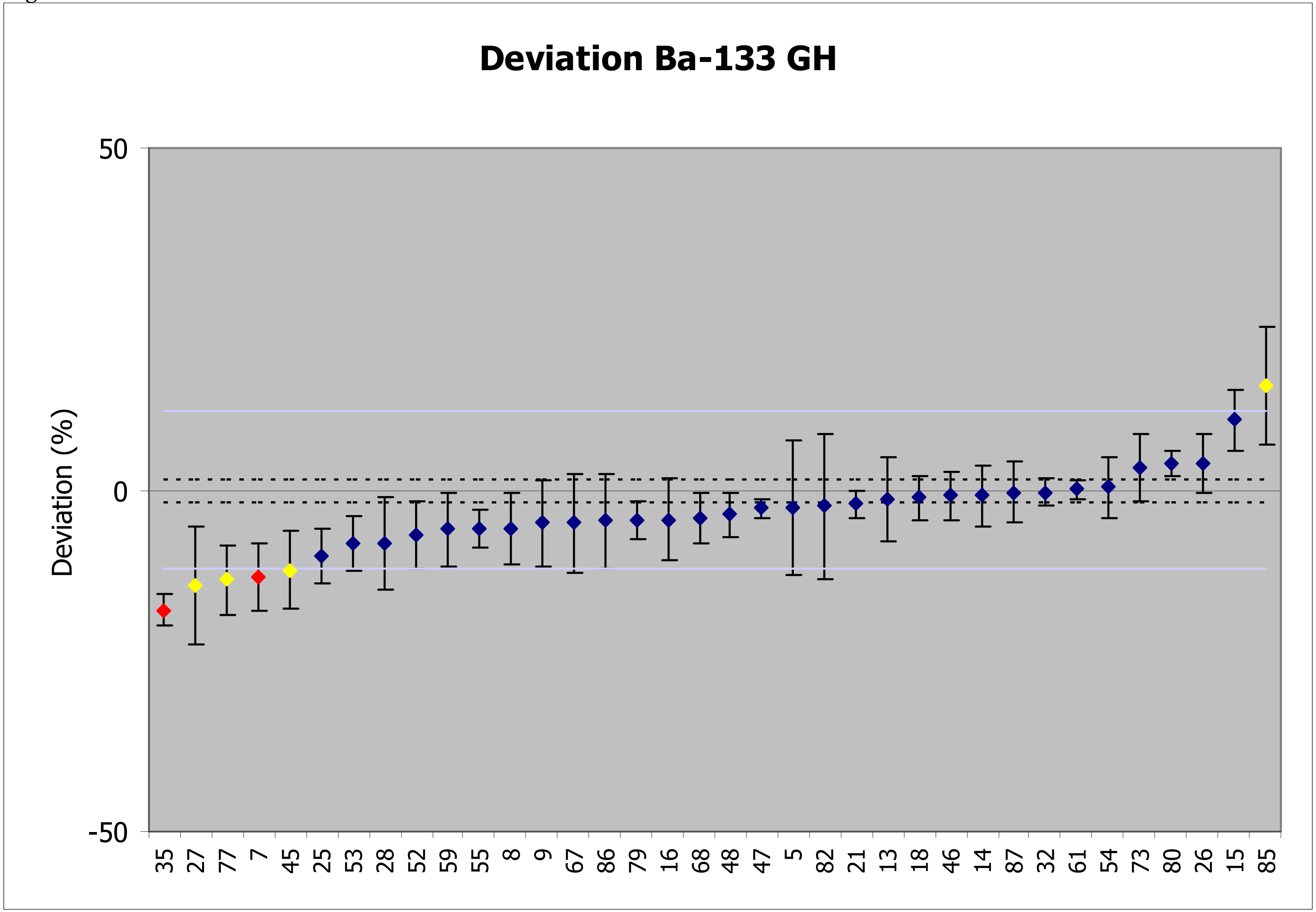


Figure 50B – Zeta score Ba-133 GH

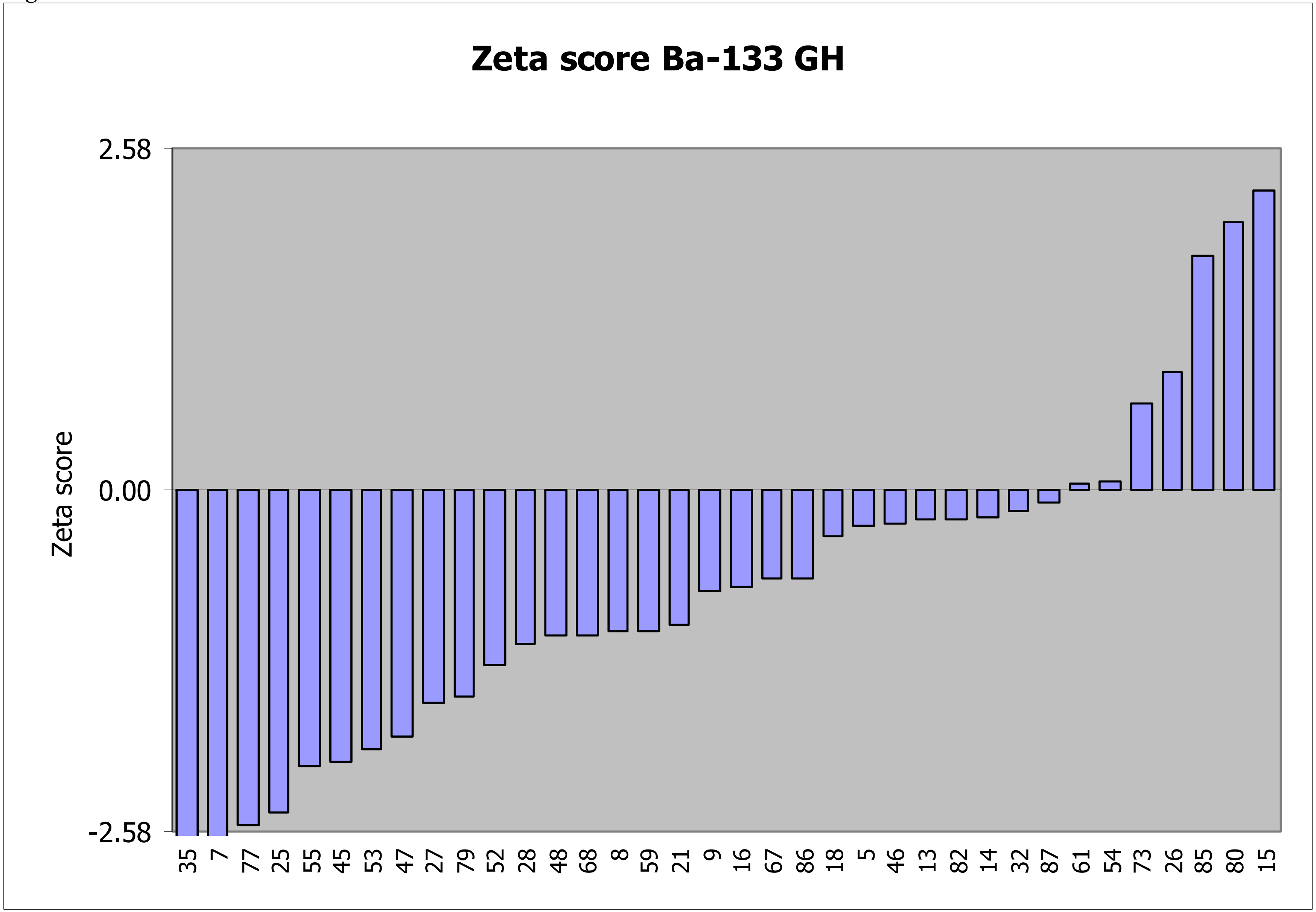


Figure 50C – Relative uncertainty Ba-133 GH

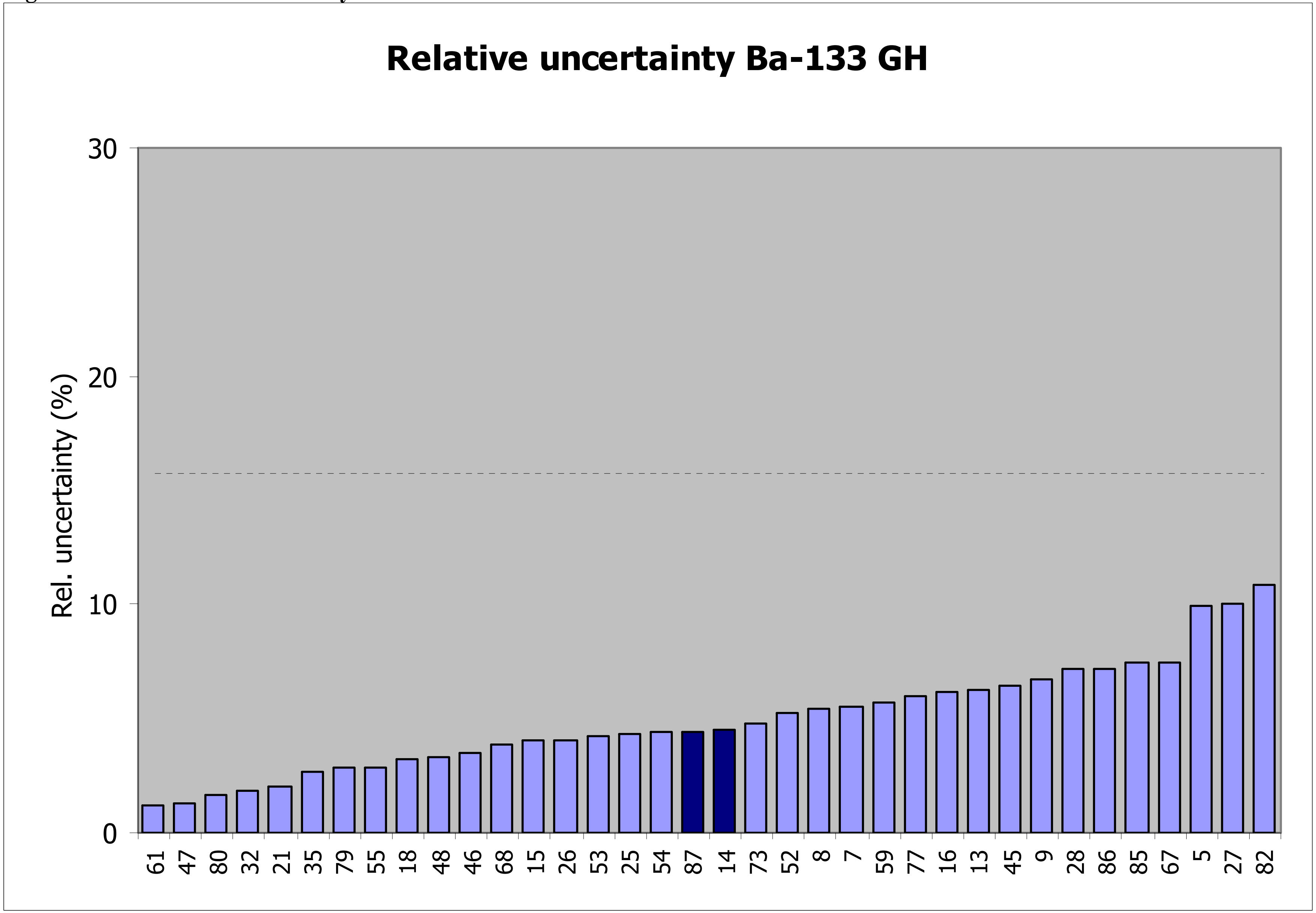


Figure 50D – Kiri plot Ba-133 GH

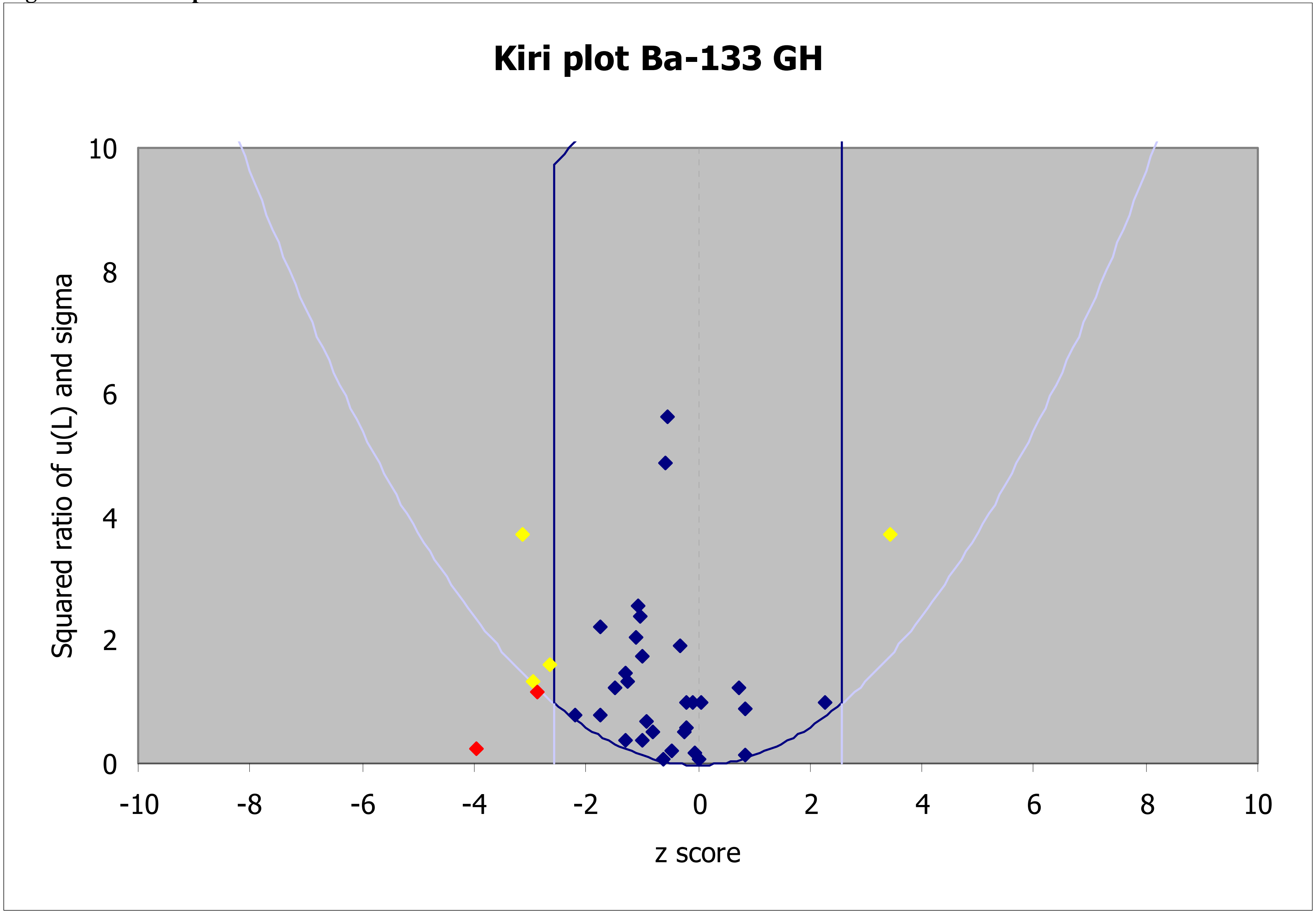


Figure 51A – Deviation Cs-134 GH

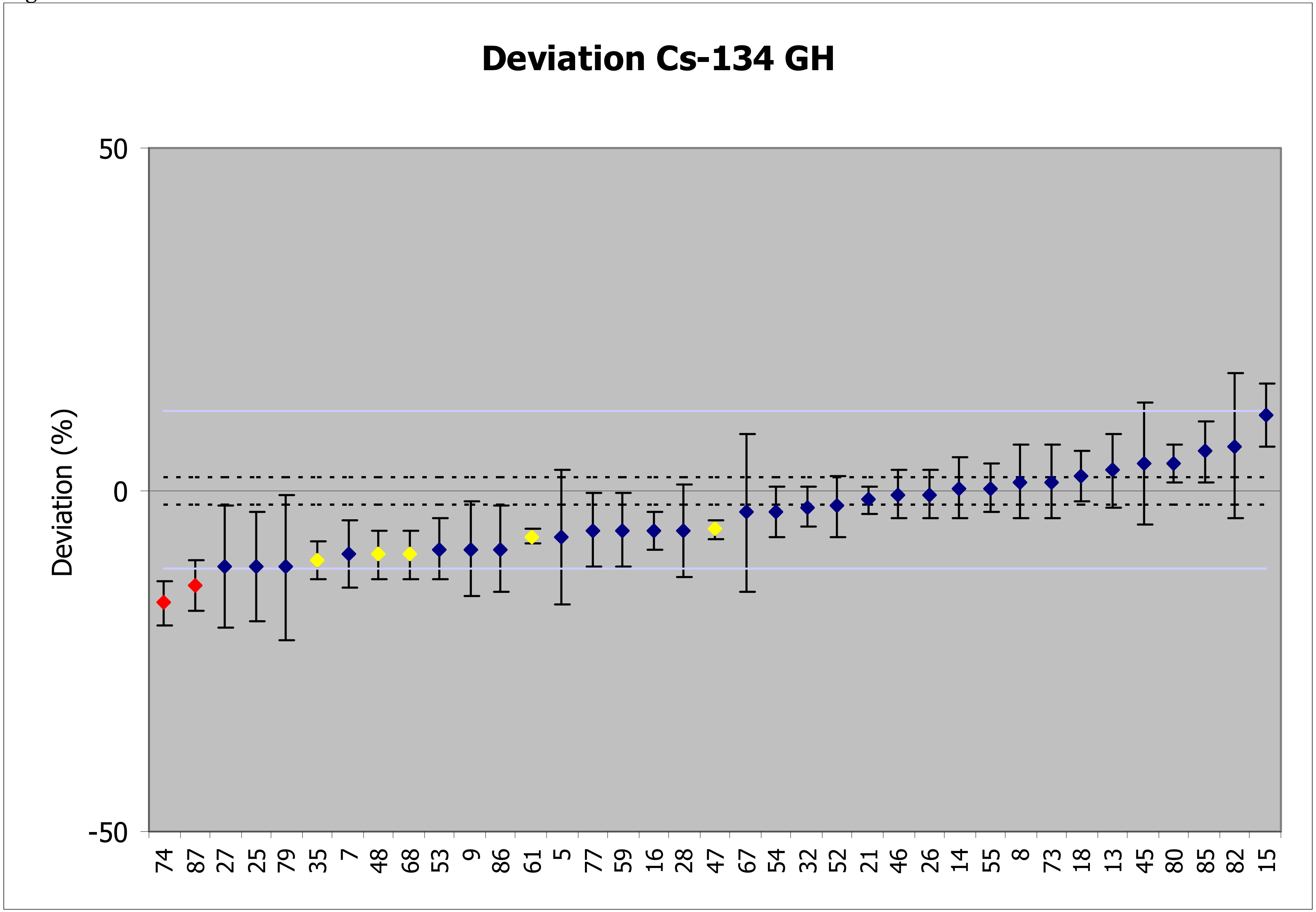


Figure 51B – Zeta score Cs-134 GH

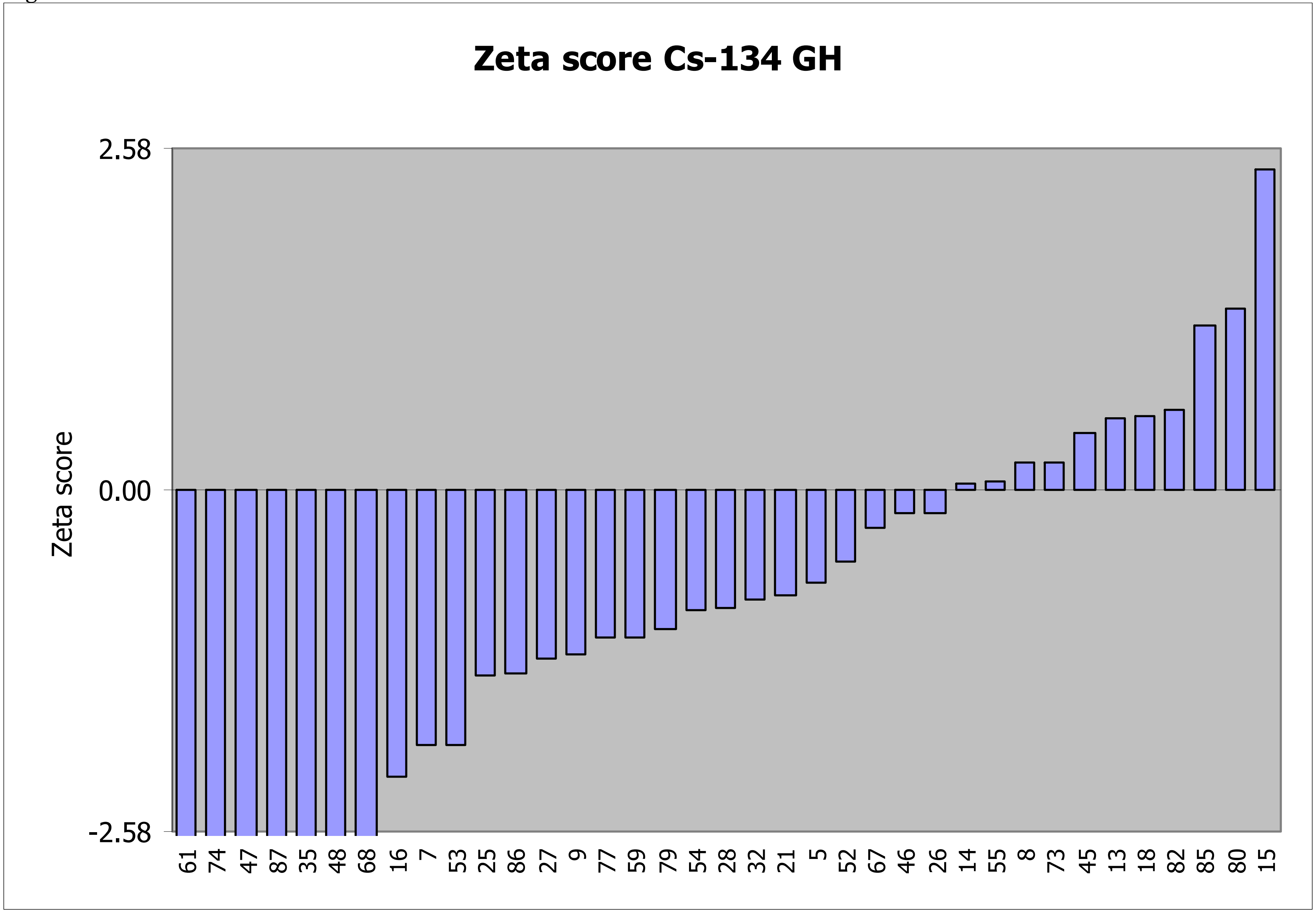


Figure 51C – Relative uncertainty Cs-134 GH

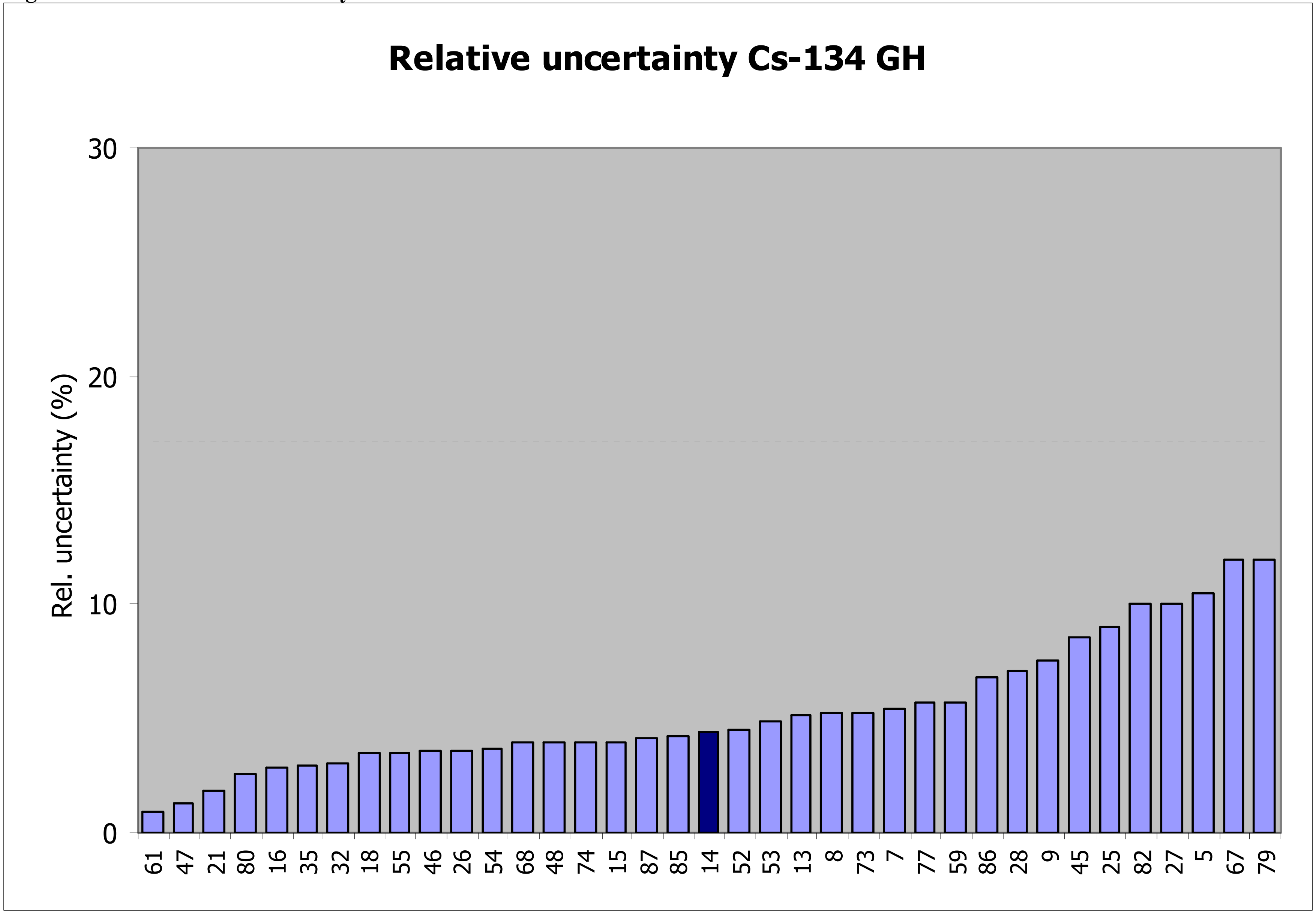


Figure 51D – Kiri plot Cs-134 GH

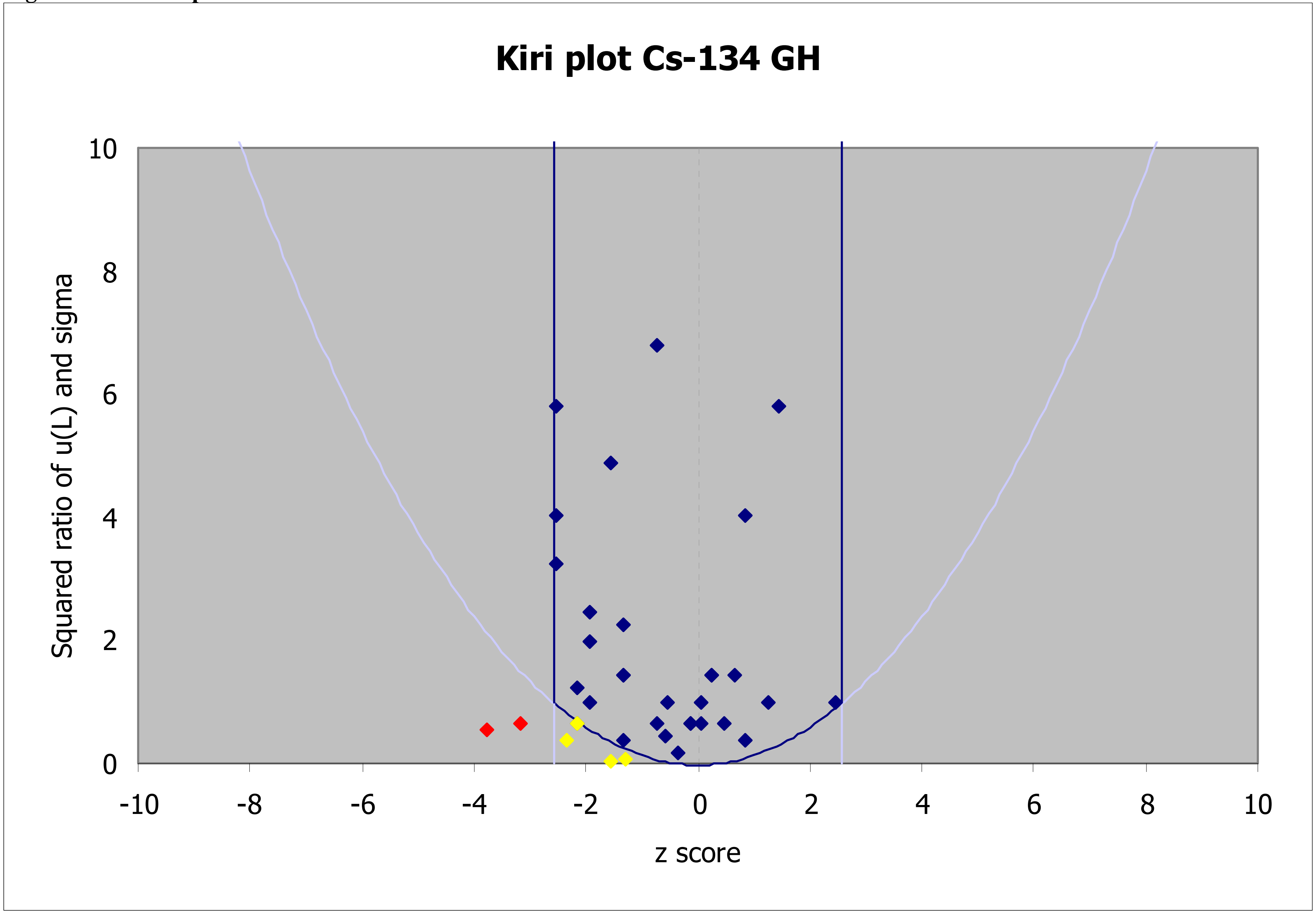


Figure 52A – Deviation Cs-137 GH

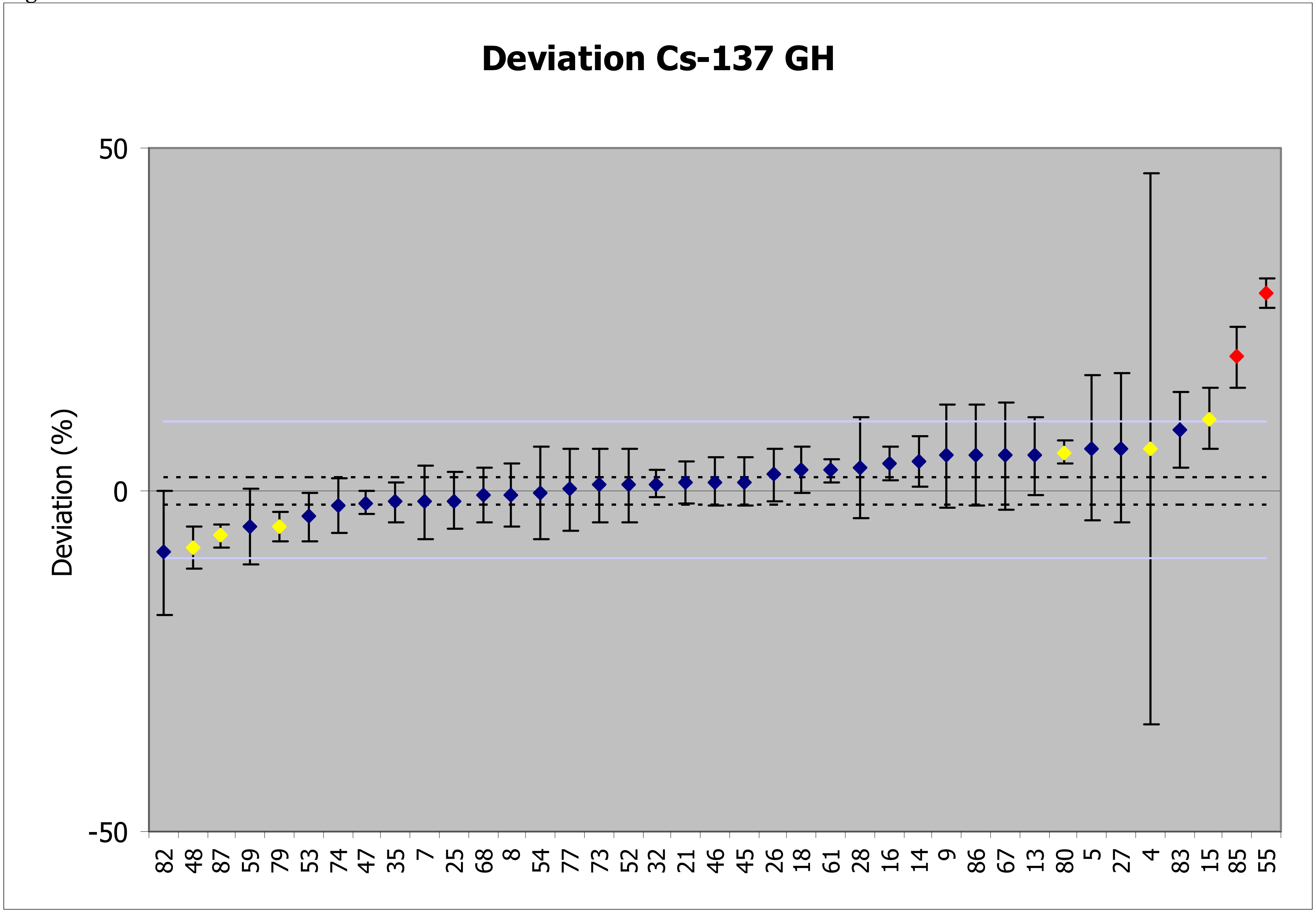


Figure 52B – Zeta score Cs-137 GH

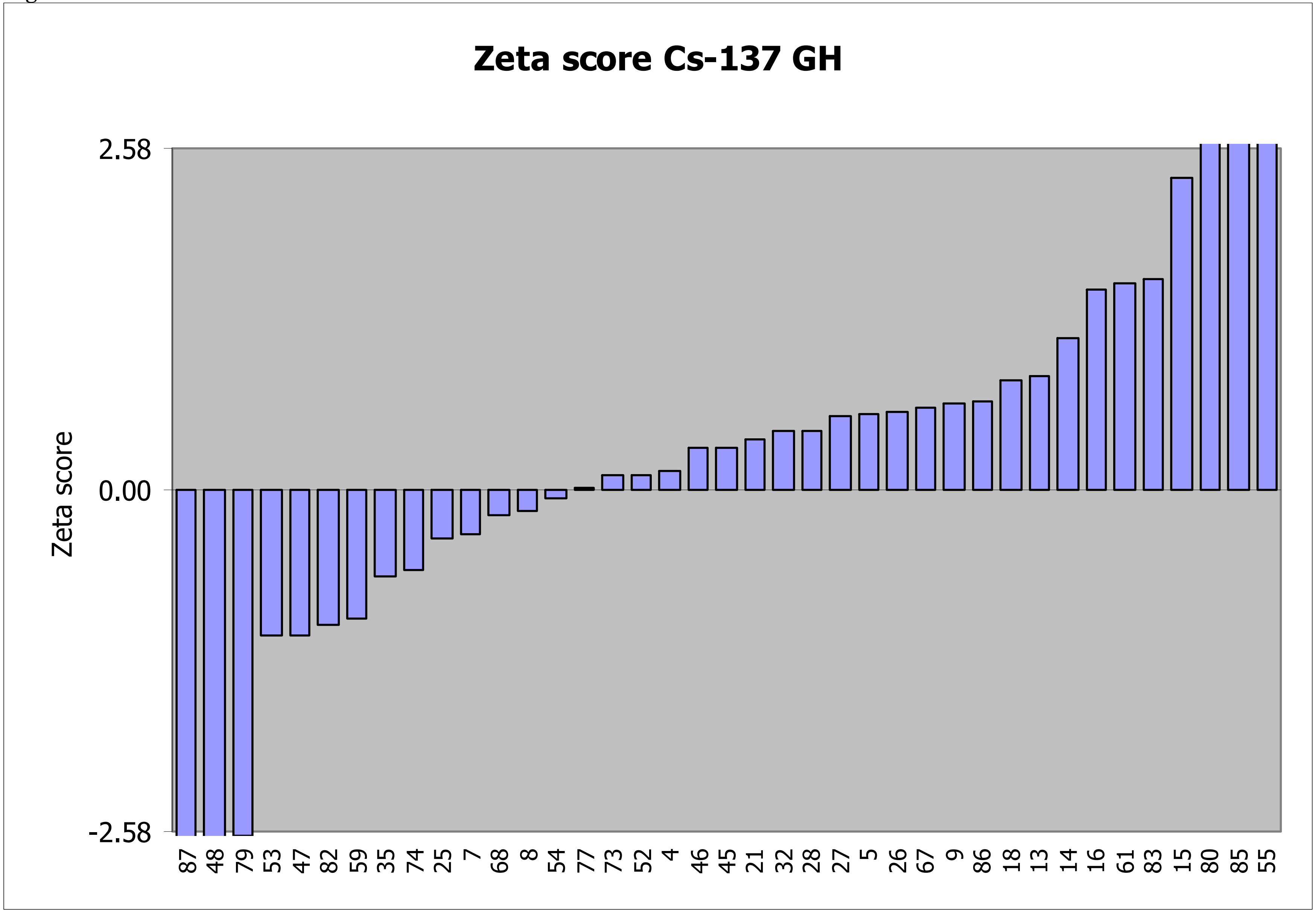


Figure 52C – Relative uncertainty Cs-137 GH

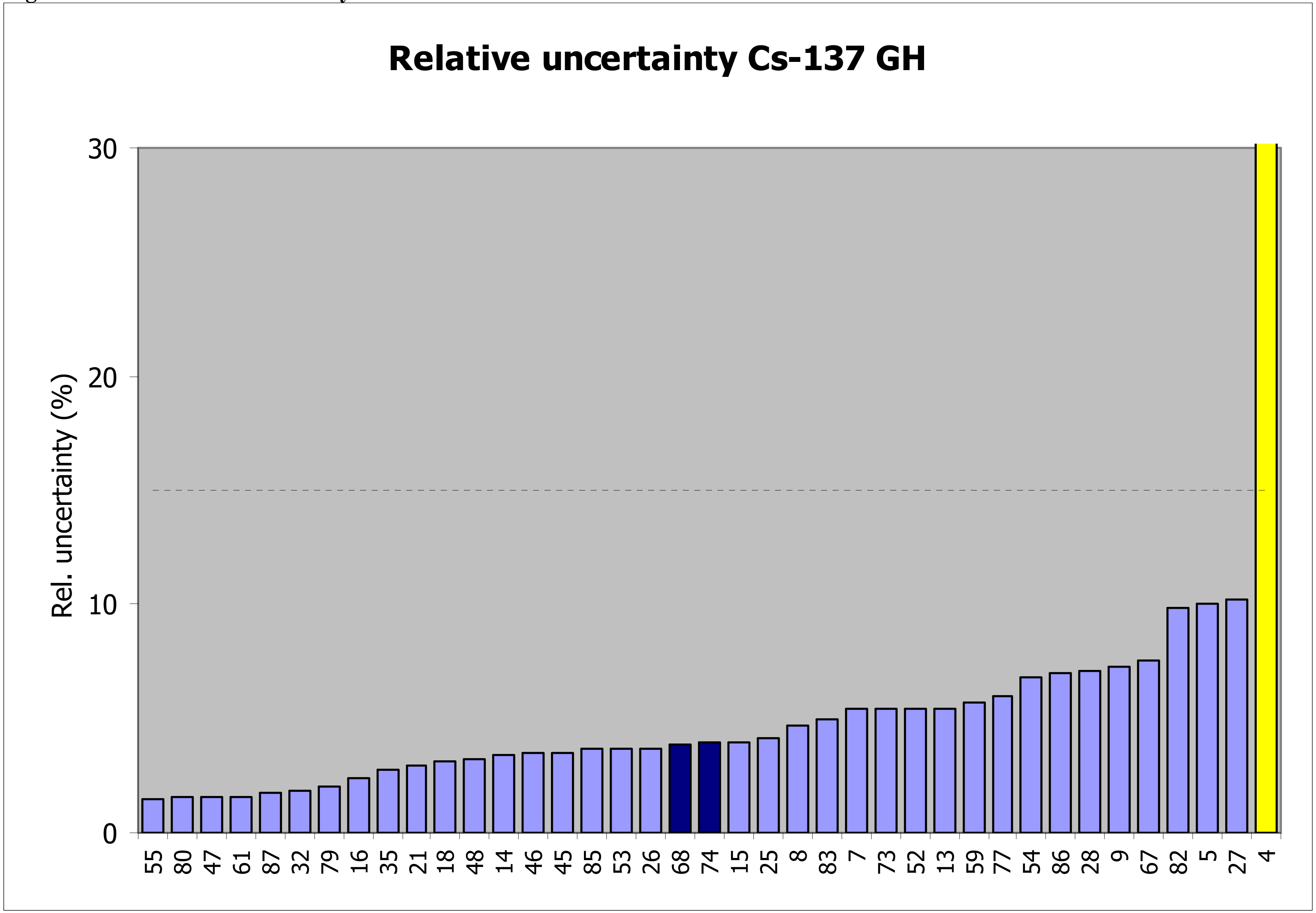


Figure 52D – Kiri plot Cs-137 GH

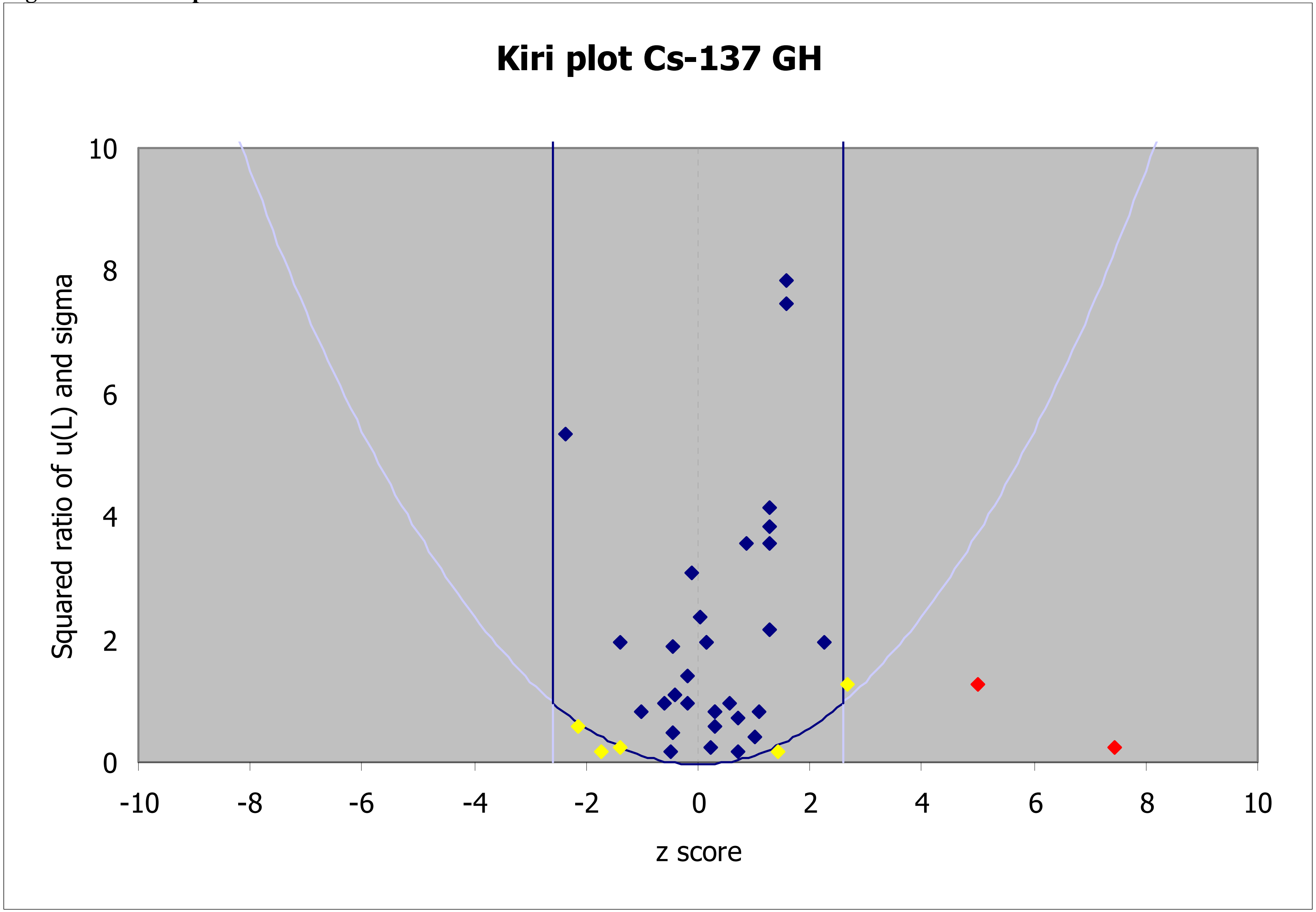


Figure 53A – Deviation Ce-144 GH

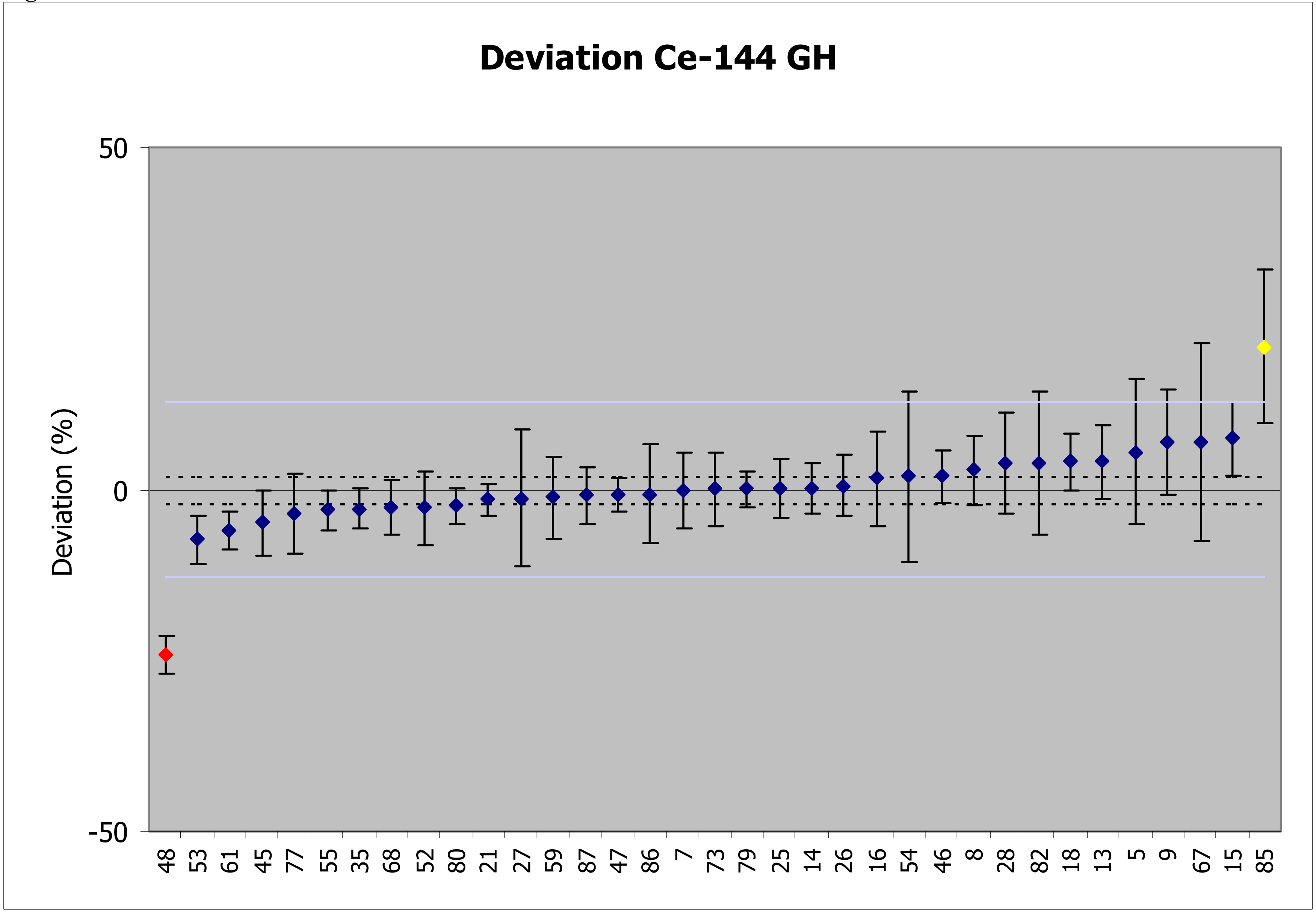


Figure 53B – Zeta score Ce-144 GH

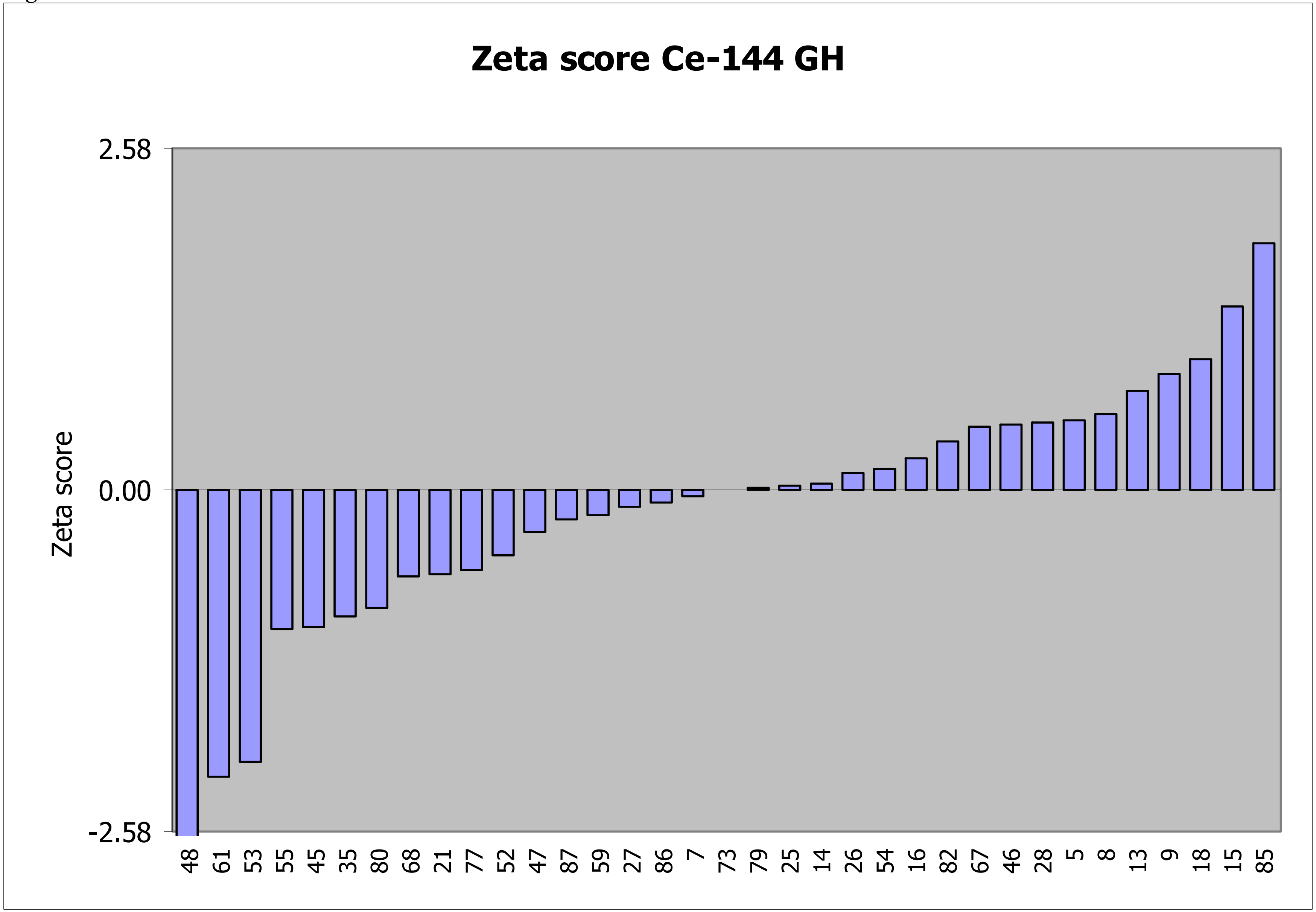


Figure 53C – Relative uncertainty Ce-144 GH

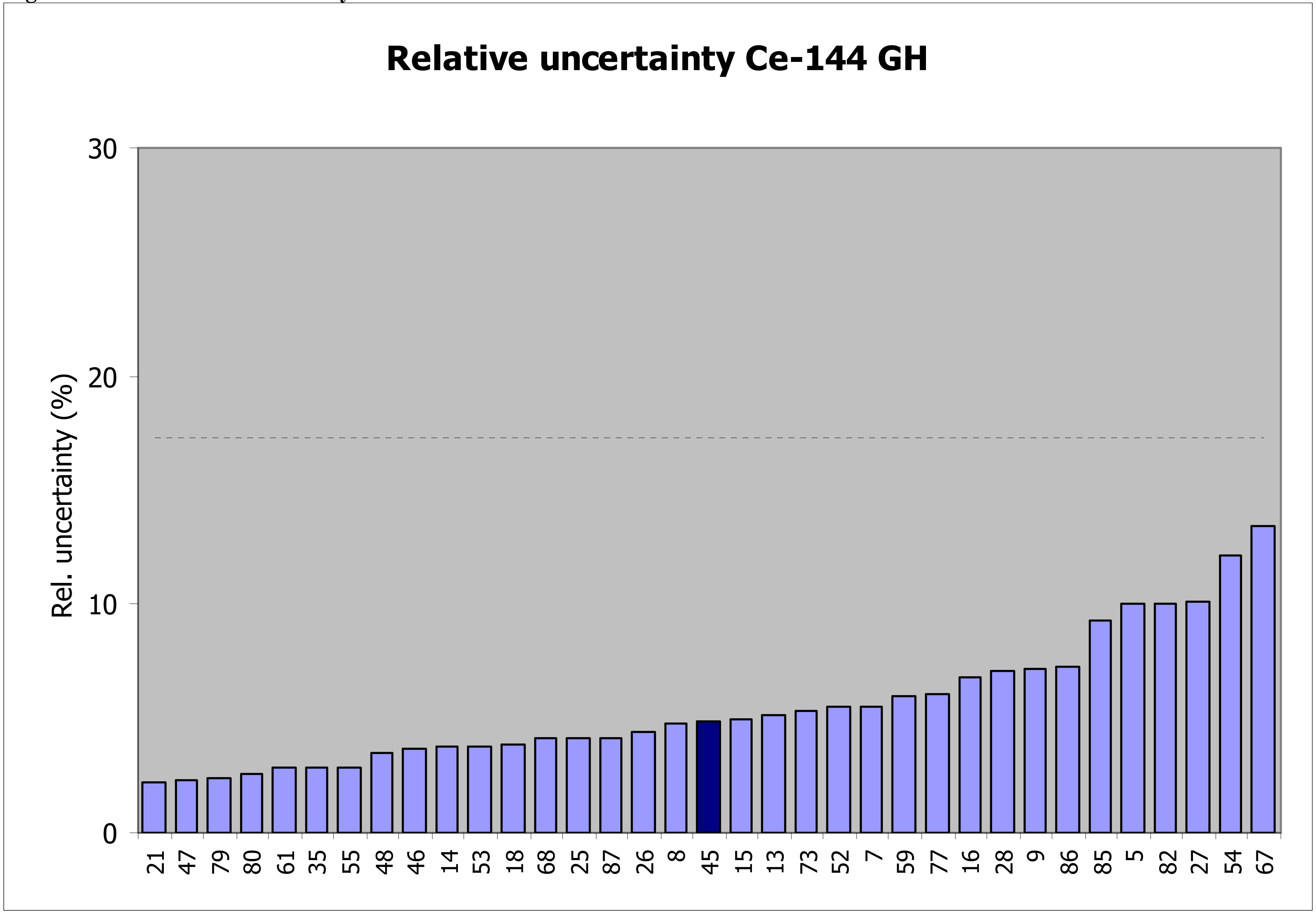


Figure 53D – Kiri plot Ce-144 GH

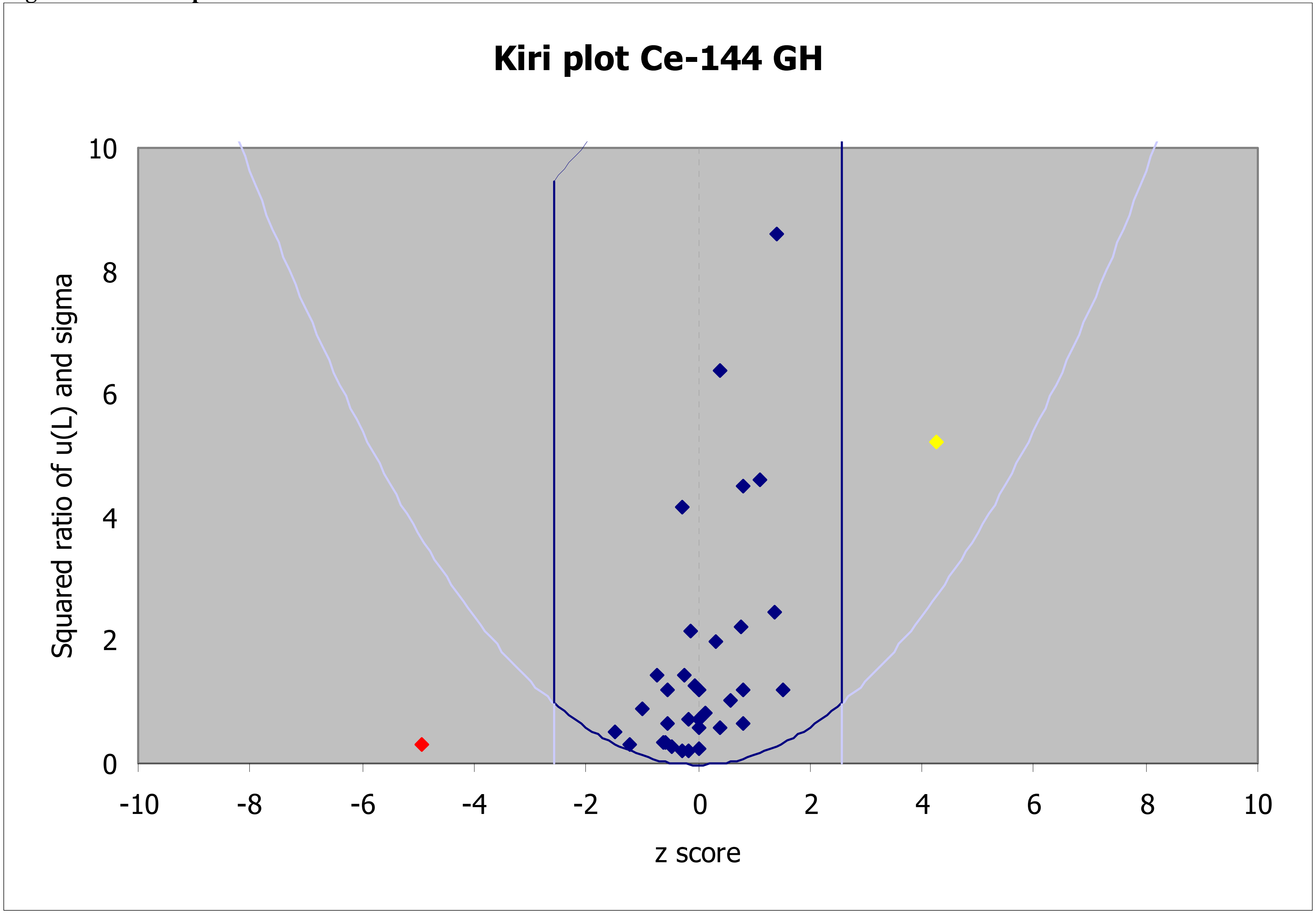


Figure 54A – Deviation Eu-152 GH

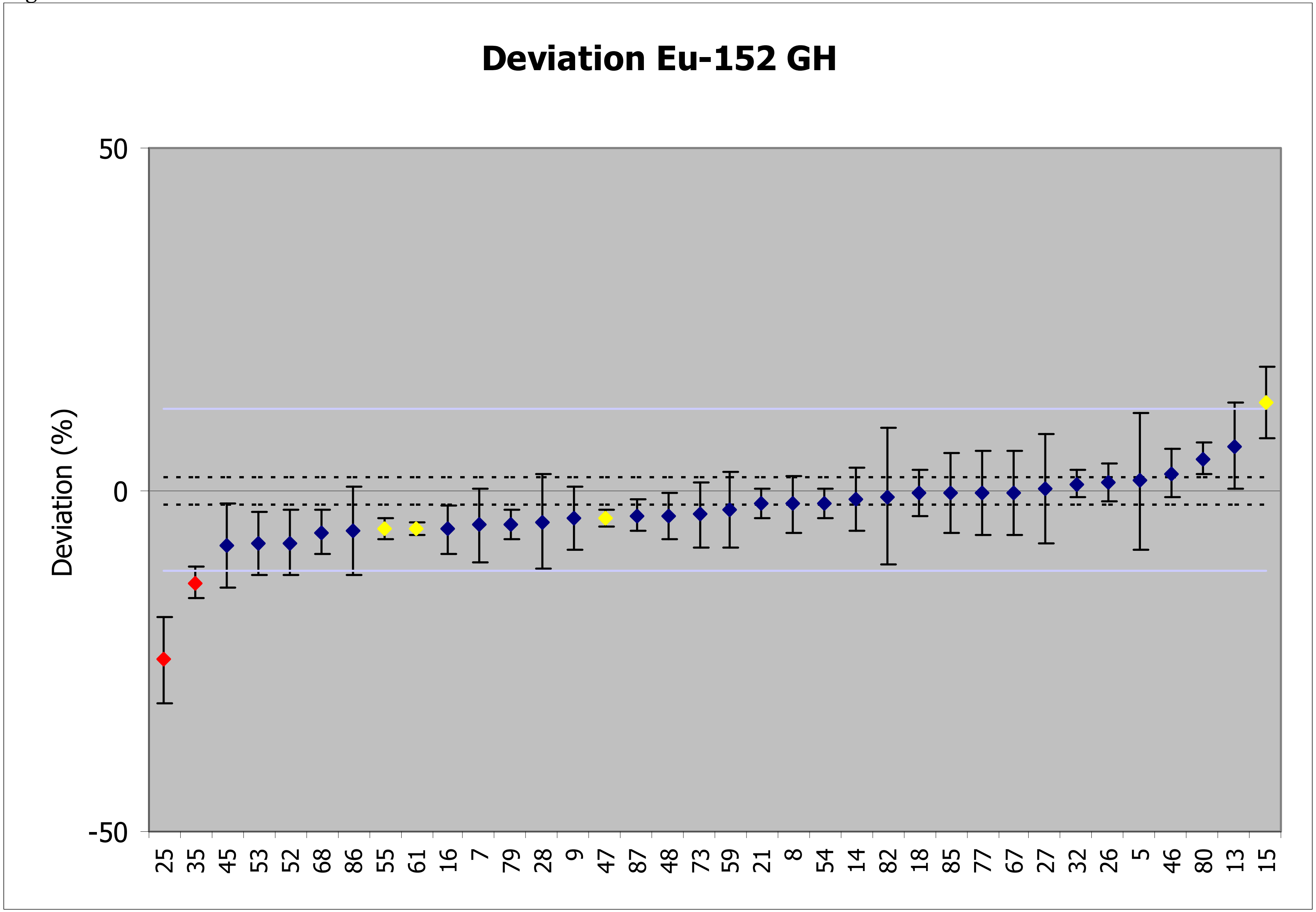


Figure 54B – Zeta score Eu-152 GH

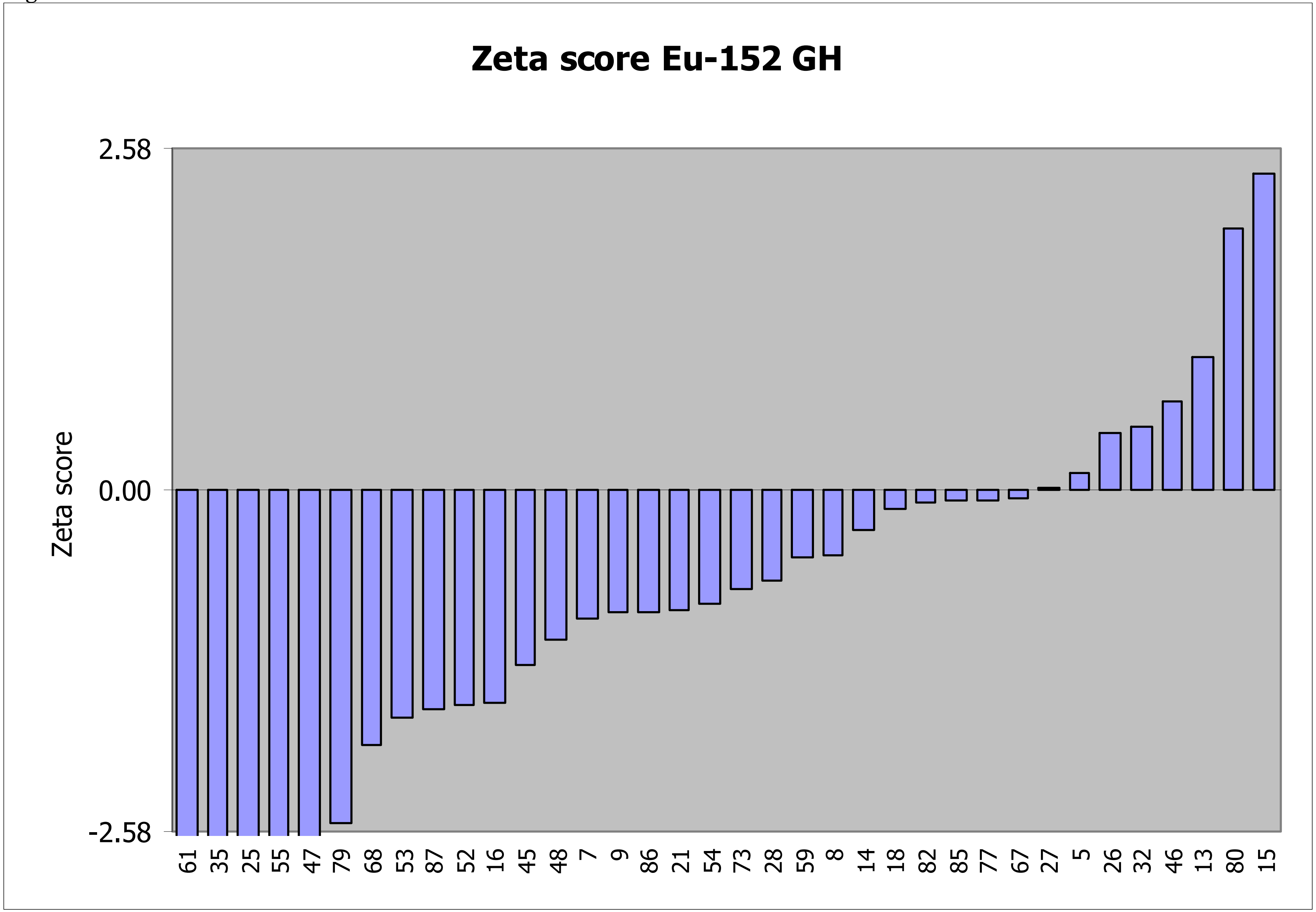


Figure 54C – Relative uncertainty Eu-152 GH

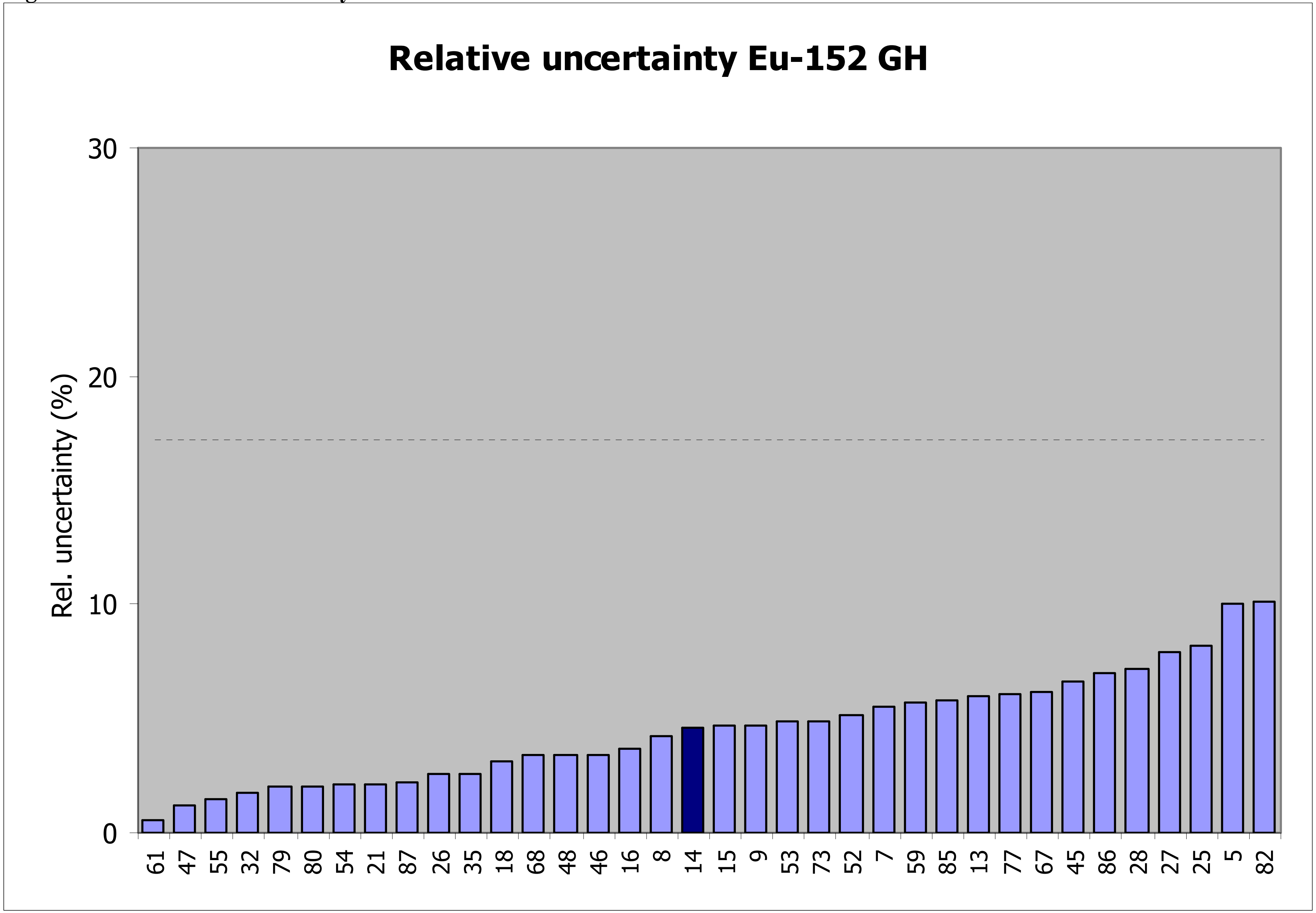


Figure 54D – Kiri plot Eu-152 GH

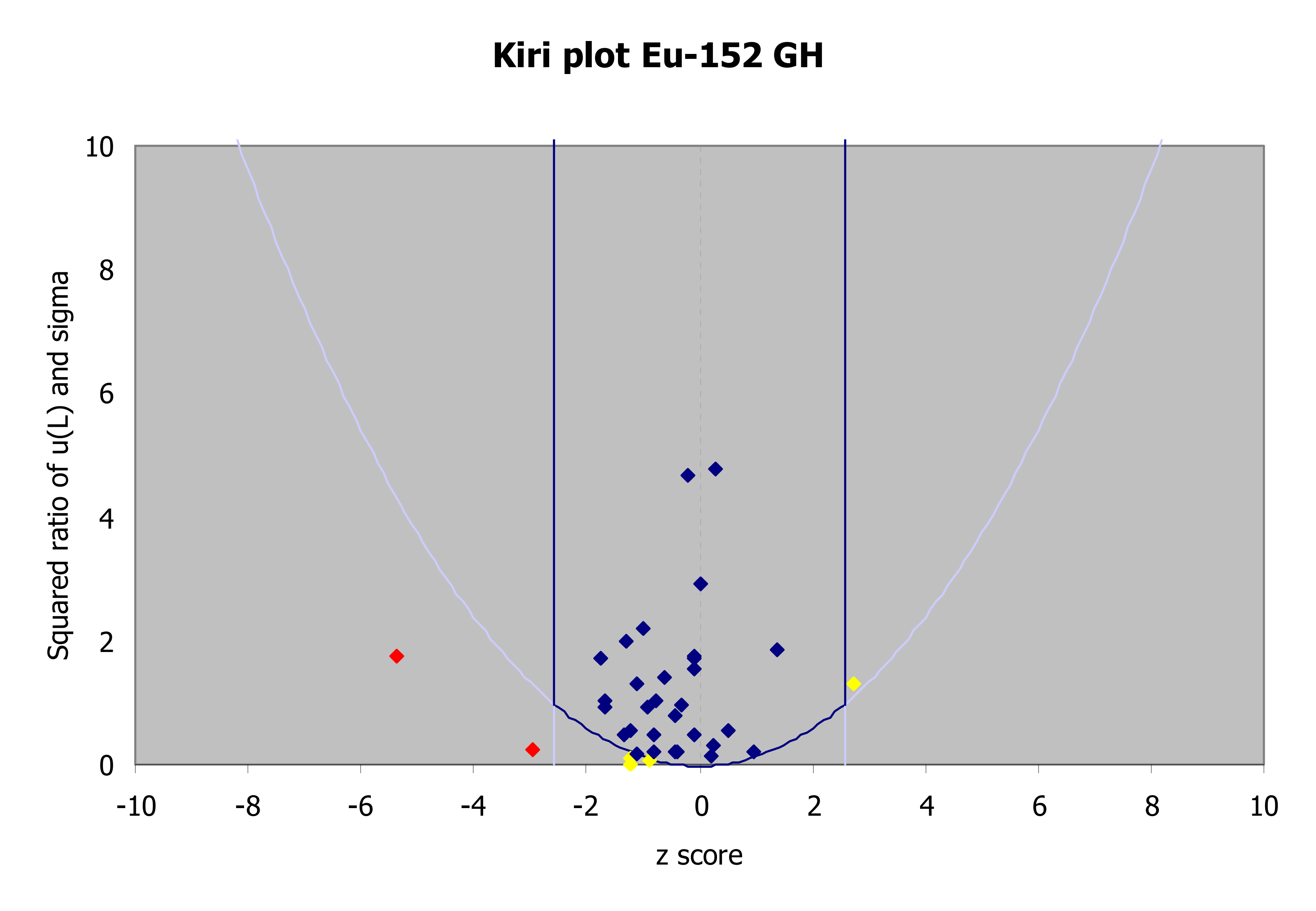


Figure 55A – Deviation Eu-155 GH

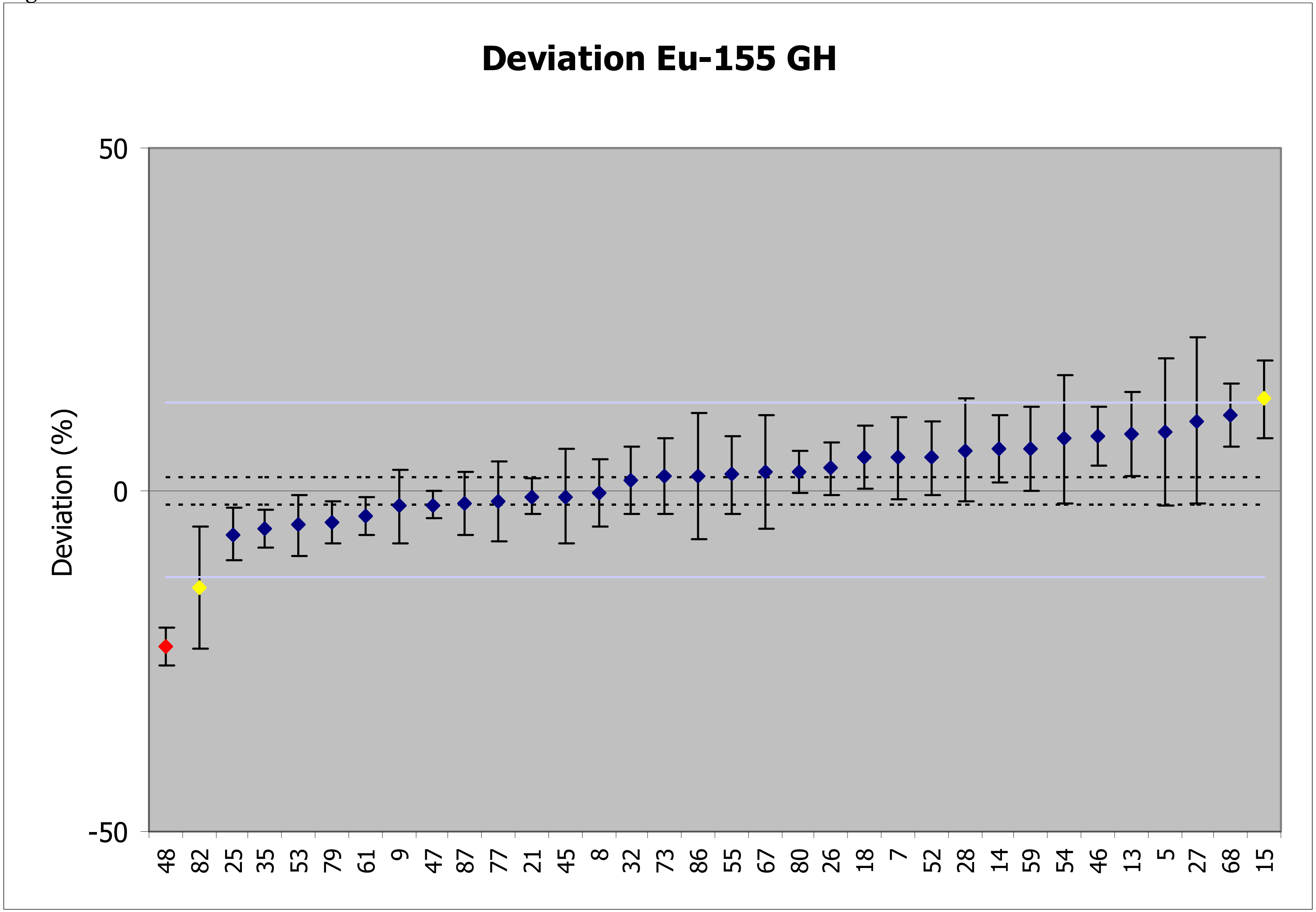


Figure 55B – Zeta score Eu-155 GH

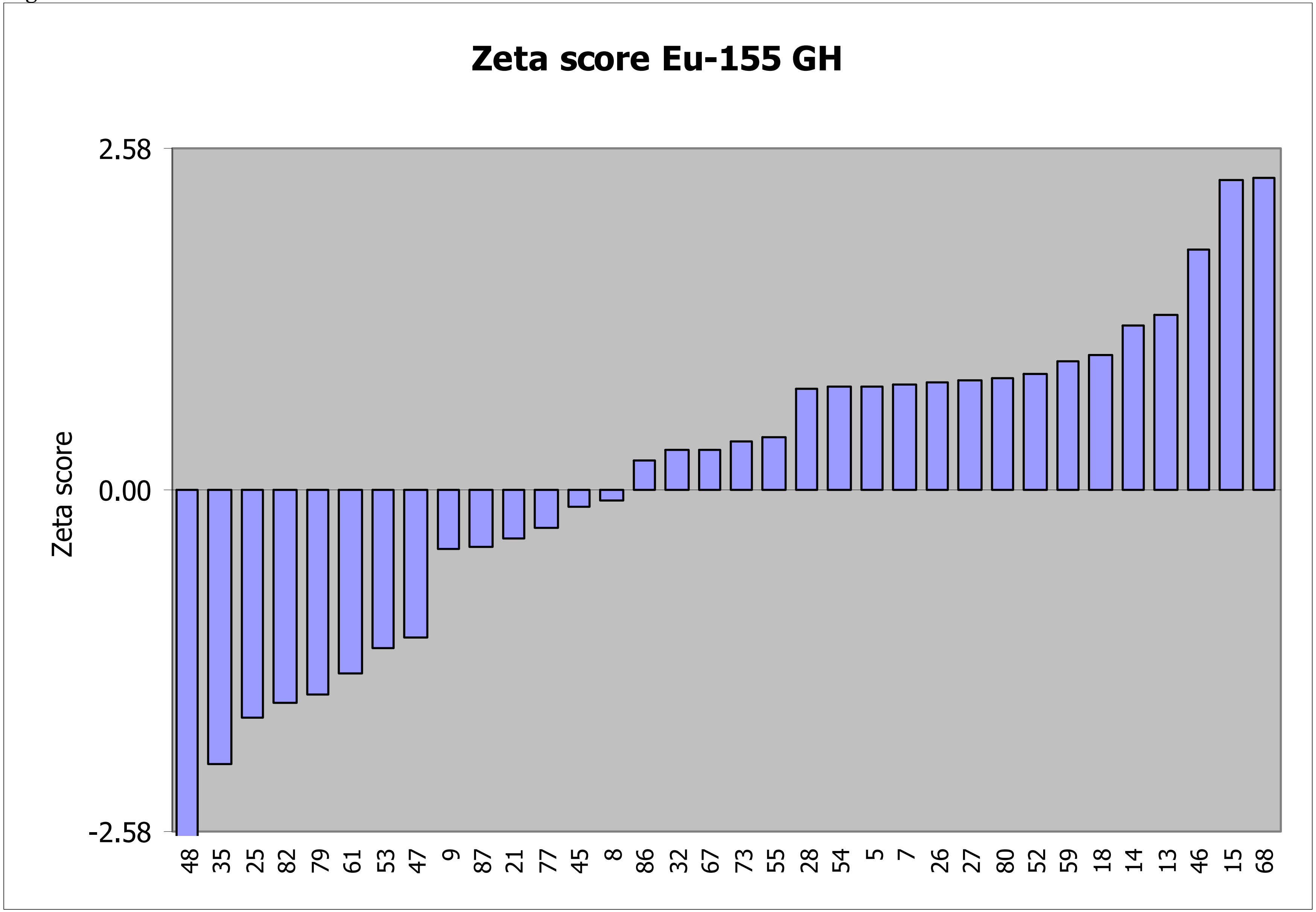


Figure 55C – Relative uncertainty Eu-155 GH

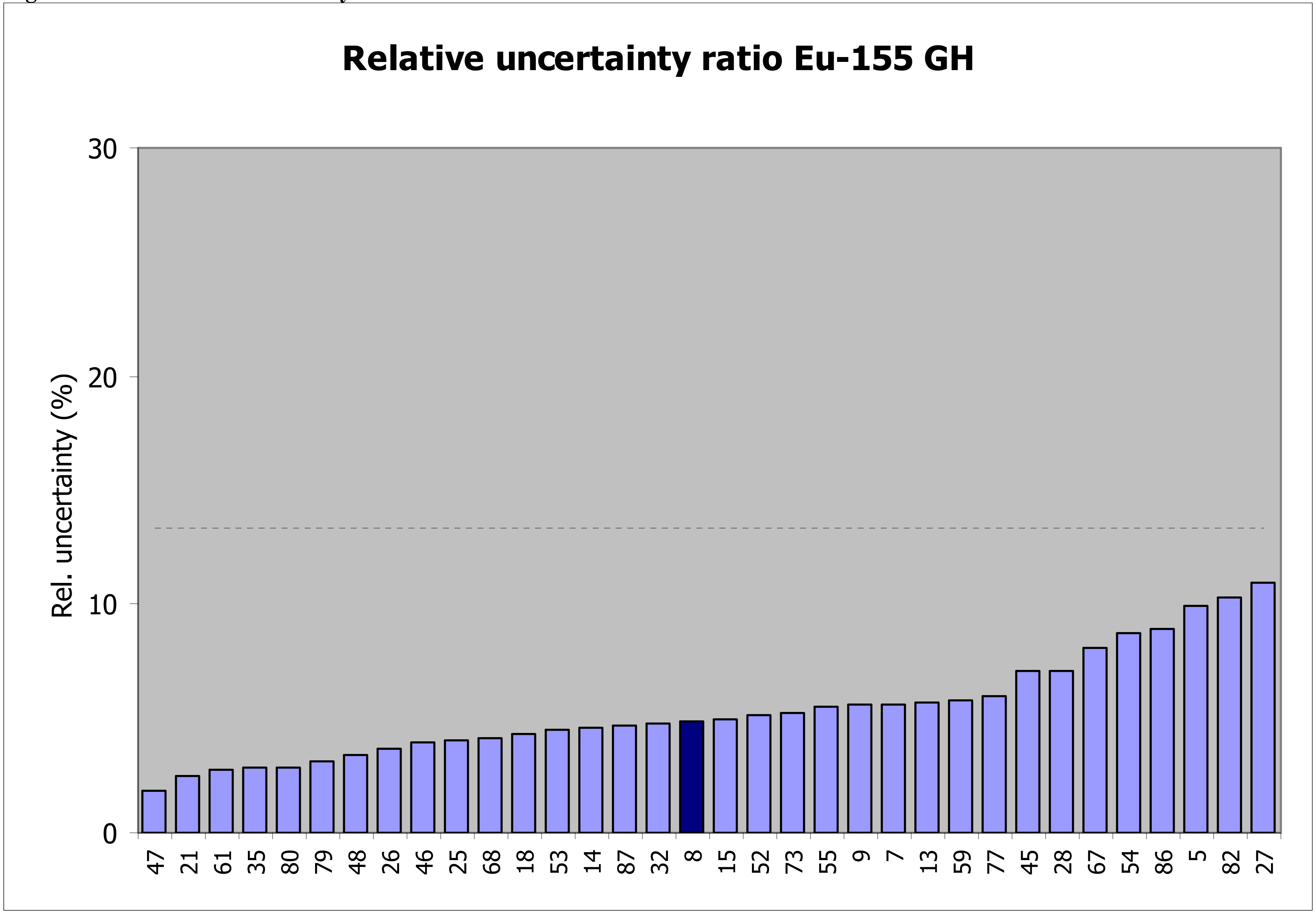


Figure 55D – Kiri plot Eu-155 GH

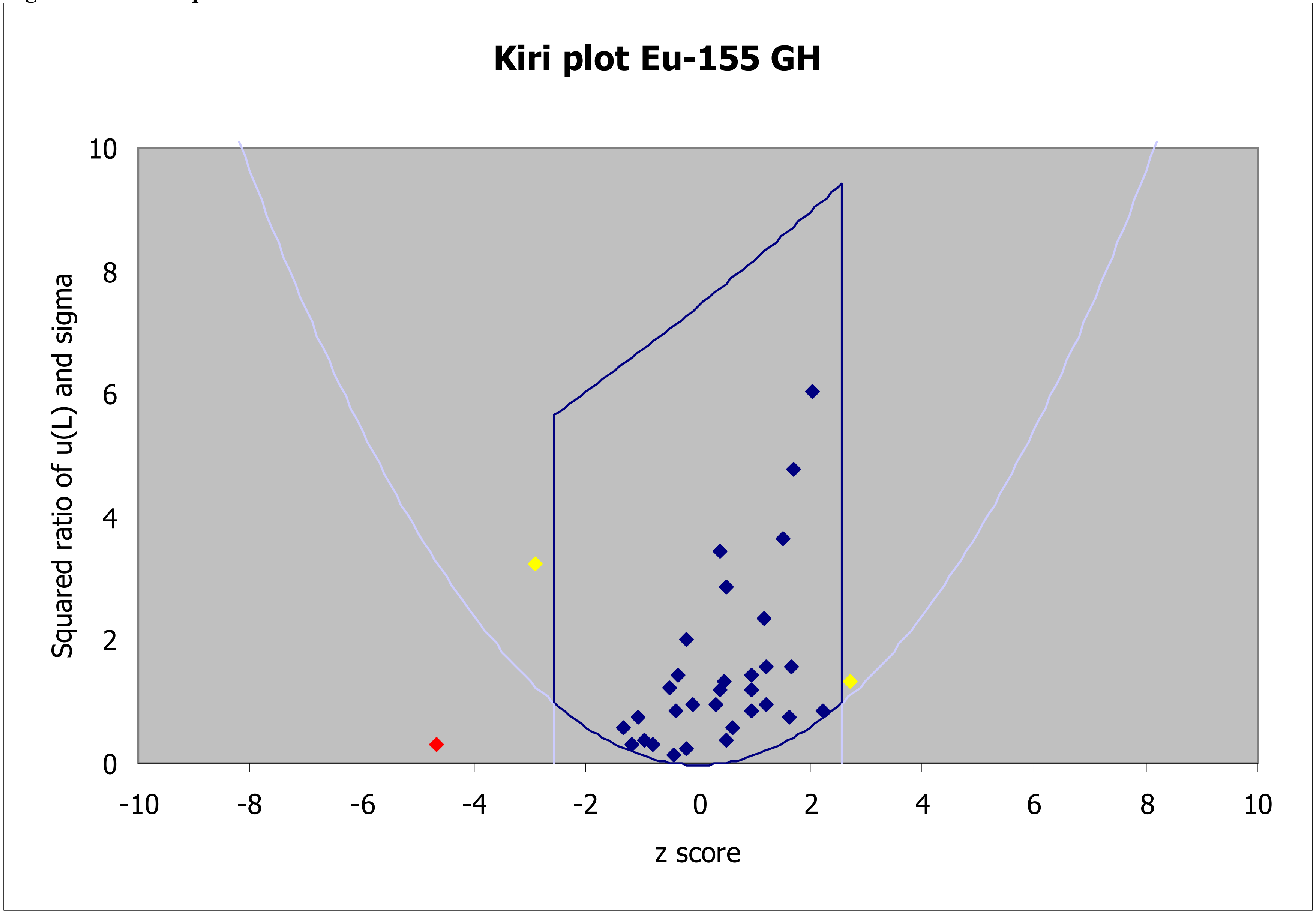


Figure 56 – H-3 total C

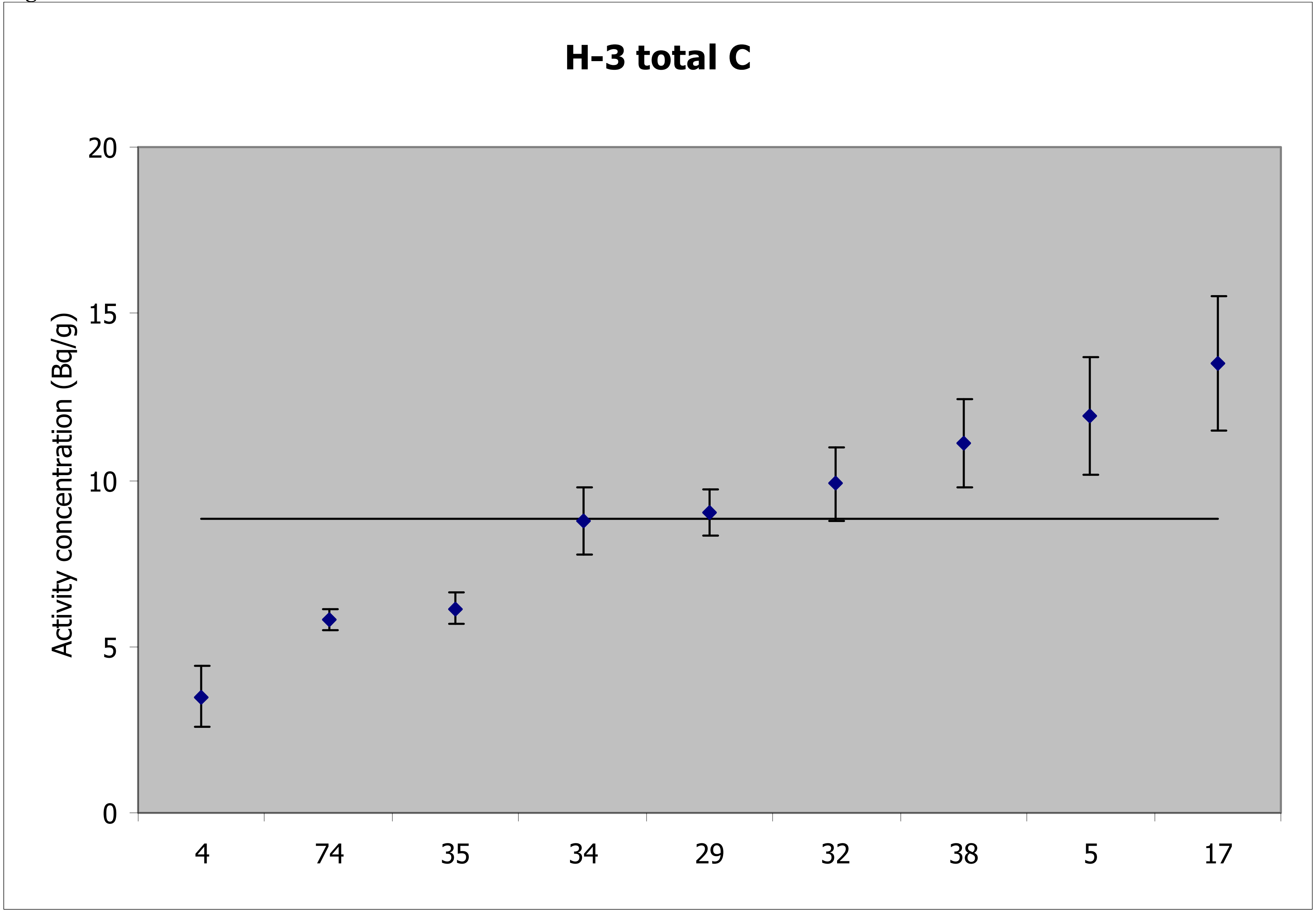


Figure 57A – H-3 leachable C

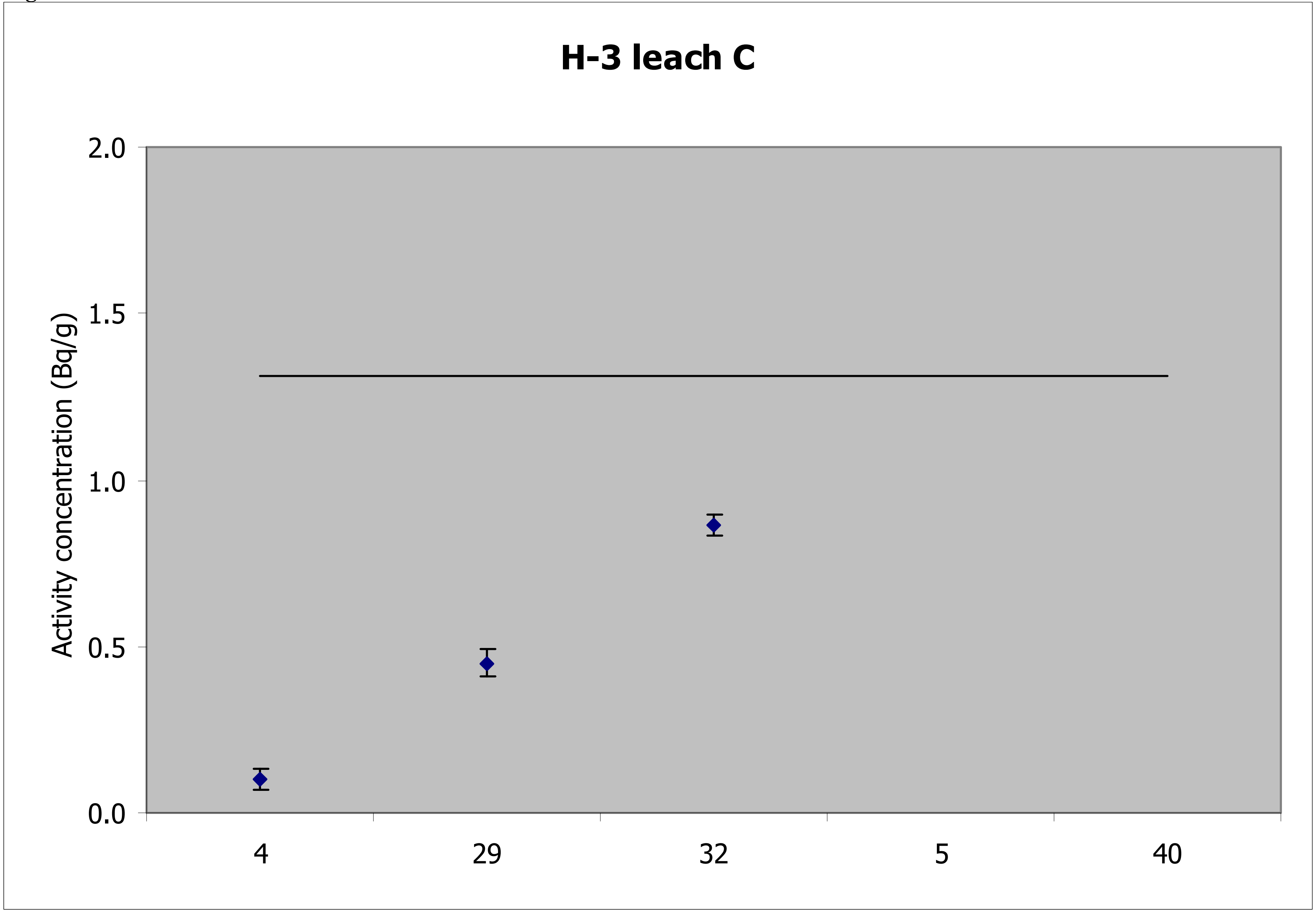


Figure 57B – H-3 fixed C

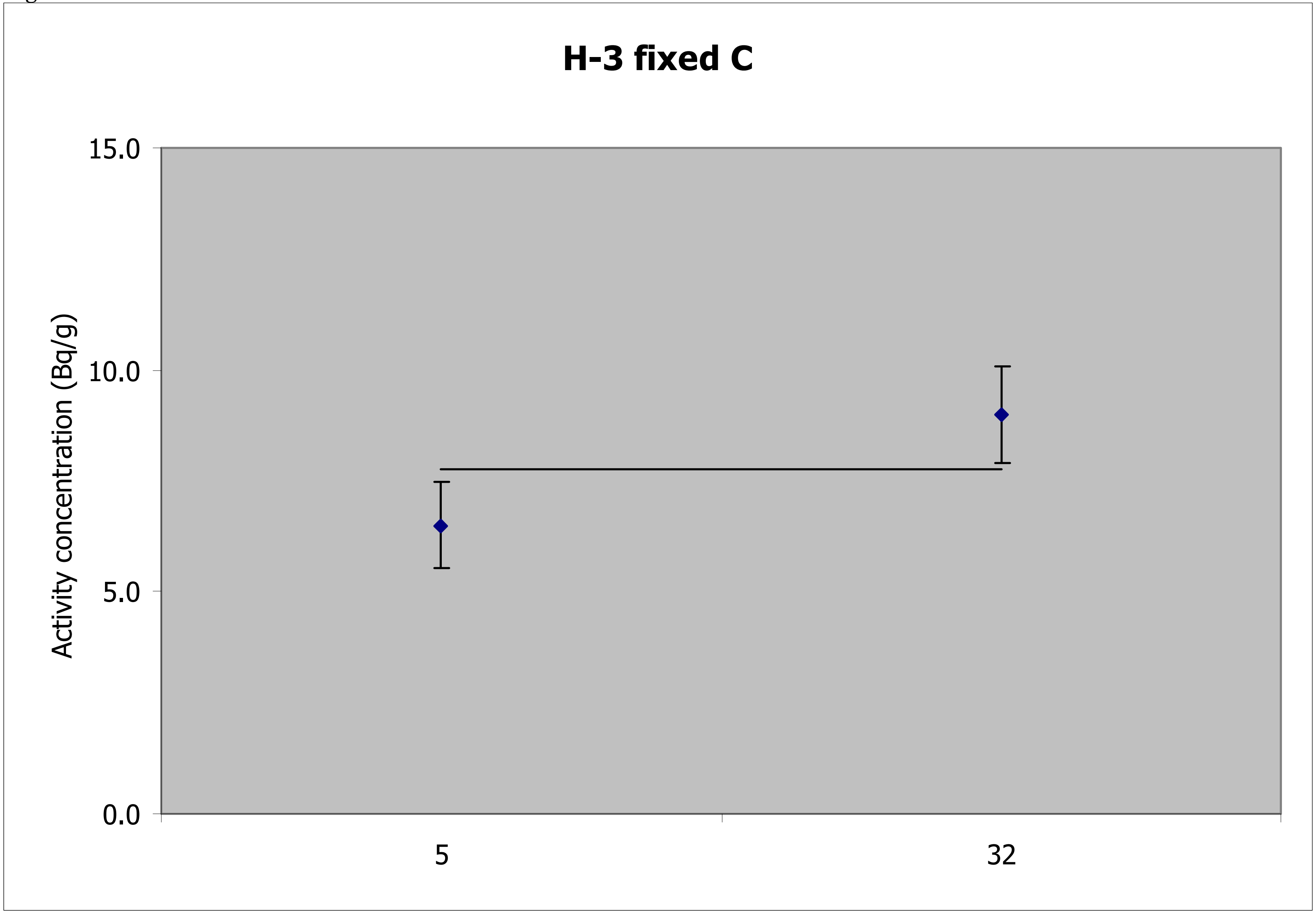


Figure 58 – C-14 C

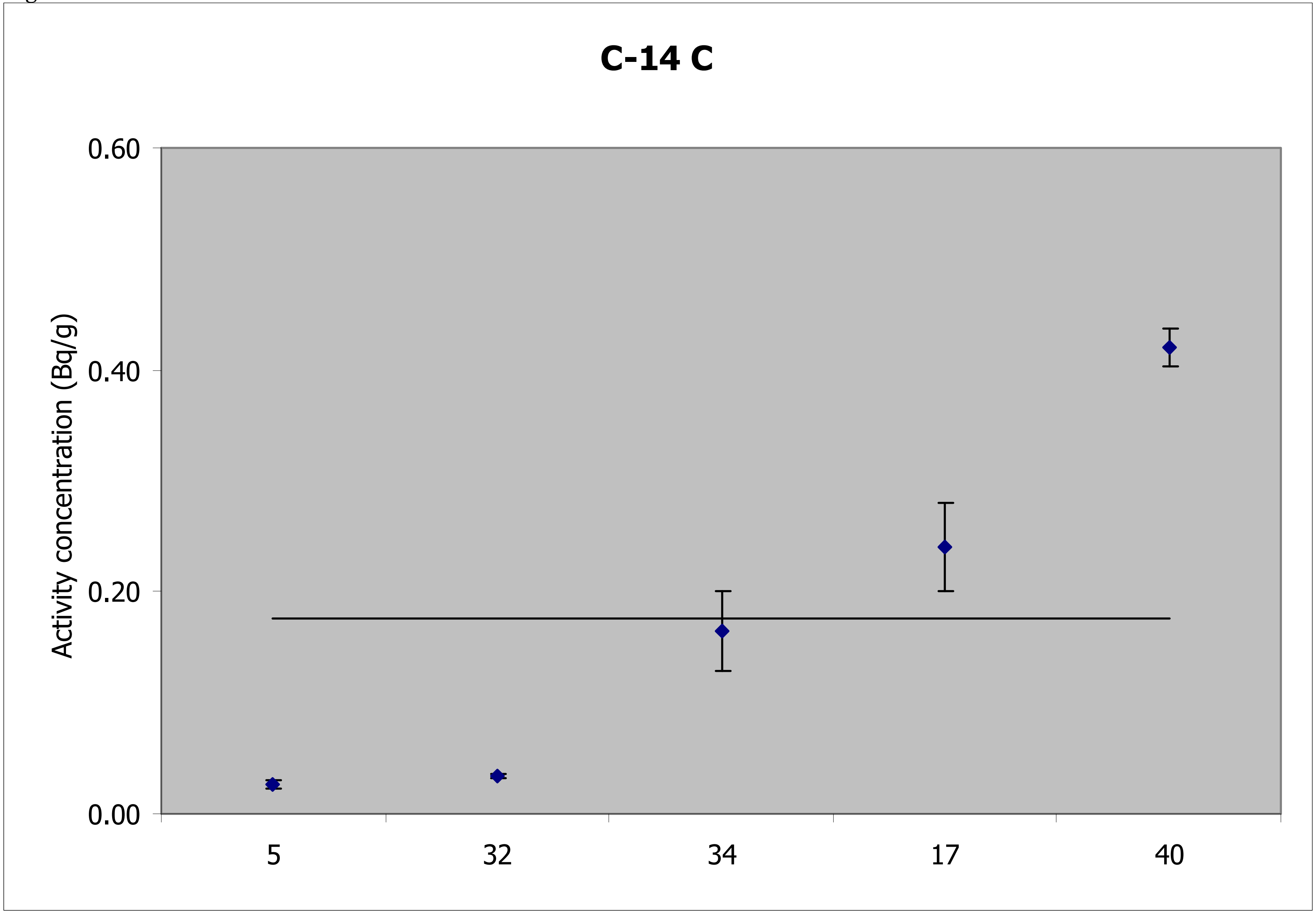


Figure 59 – K-40 C

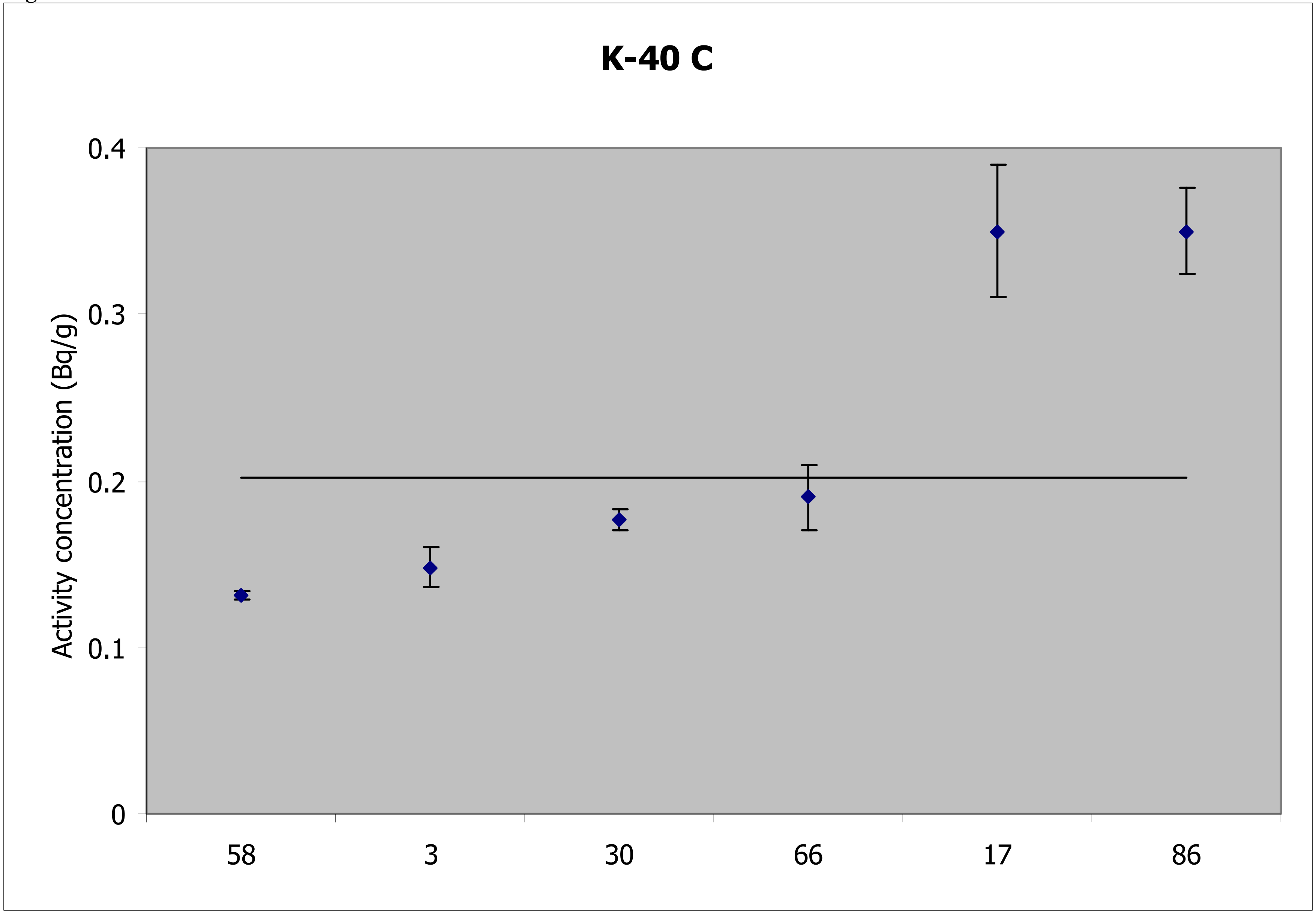


Figure 60 – Ca-41 C

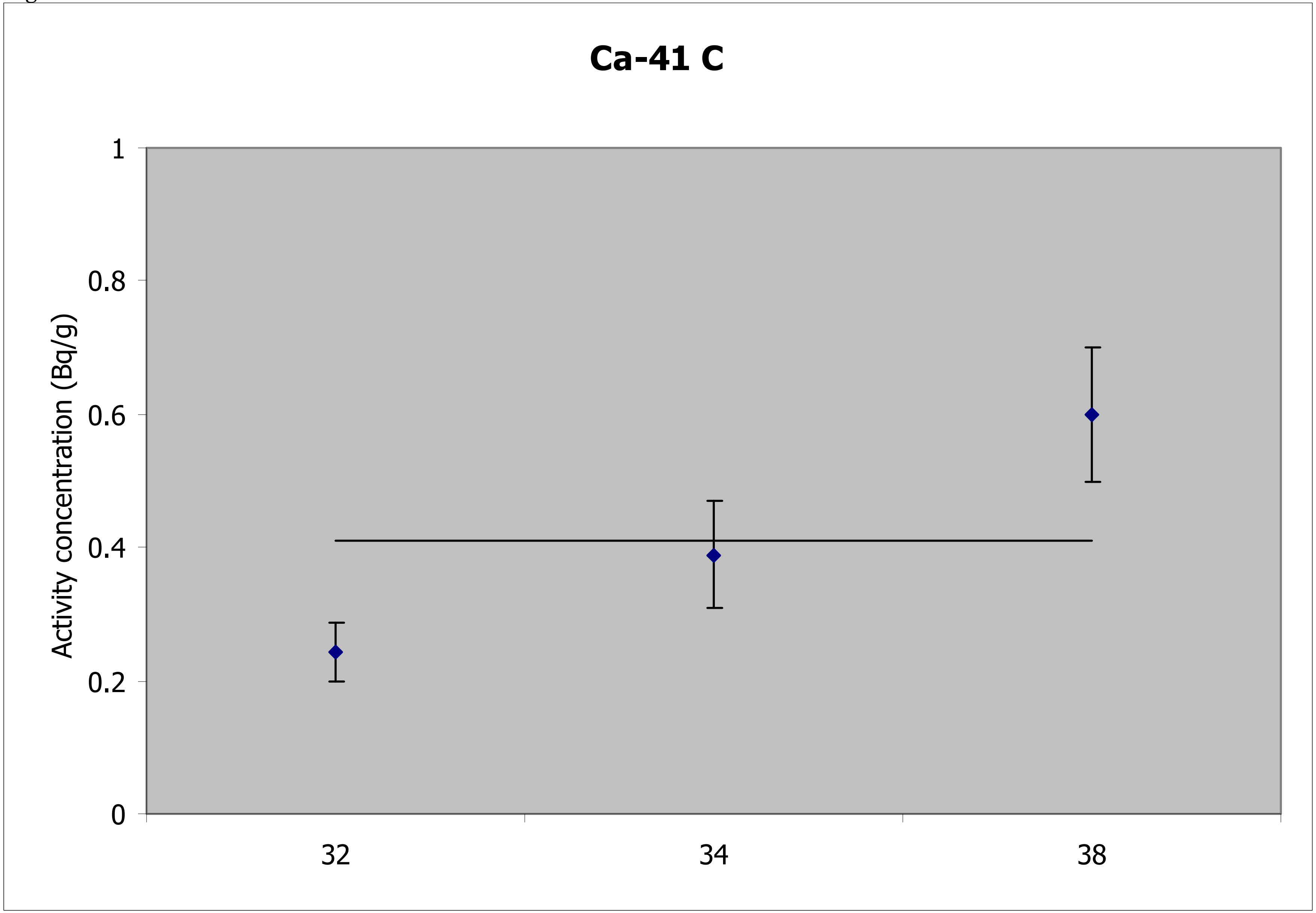


Figure 61 – Fe-55 C

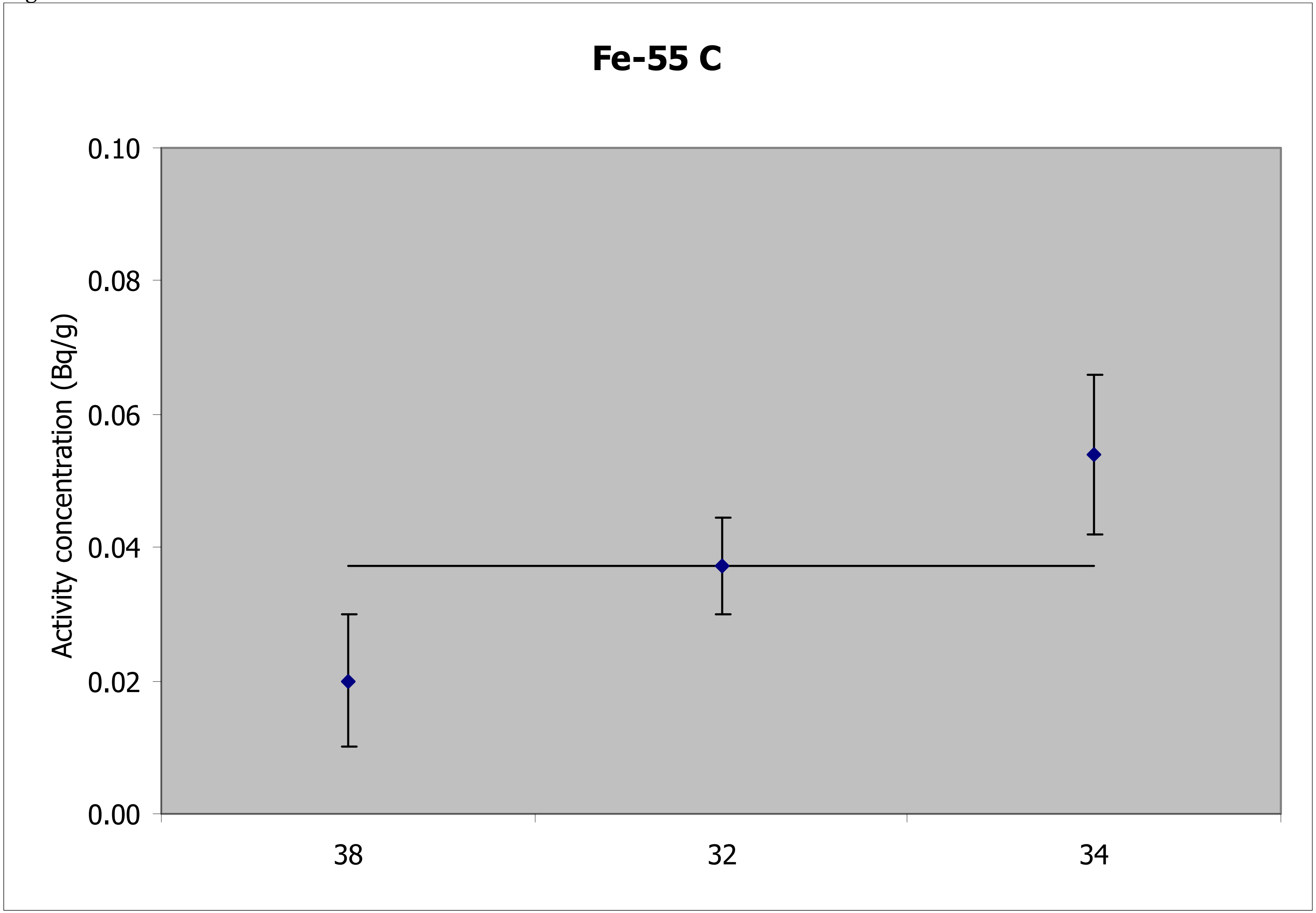


Figure 62A – Co-60 C

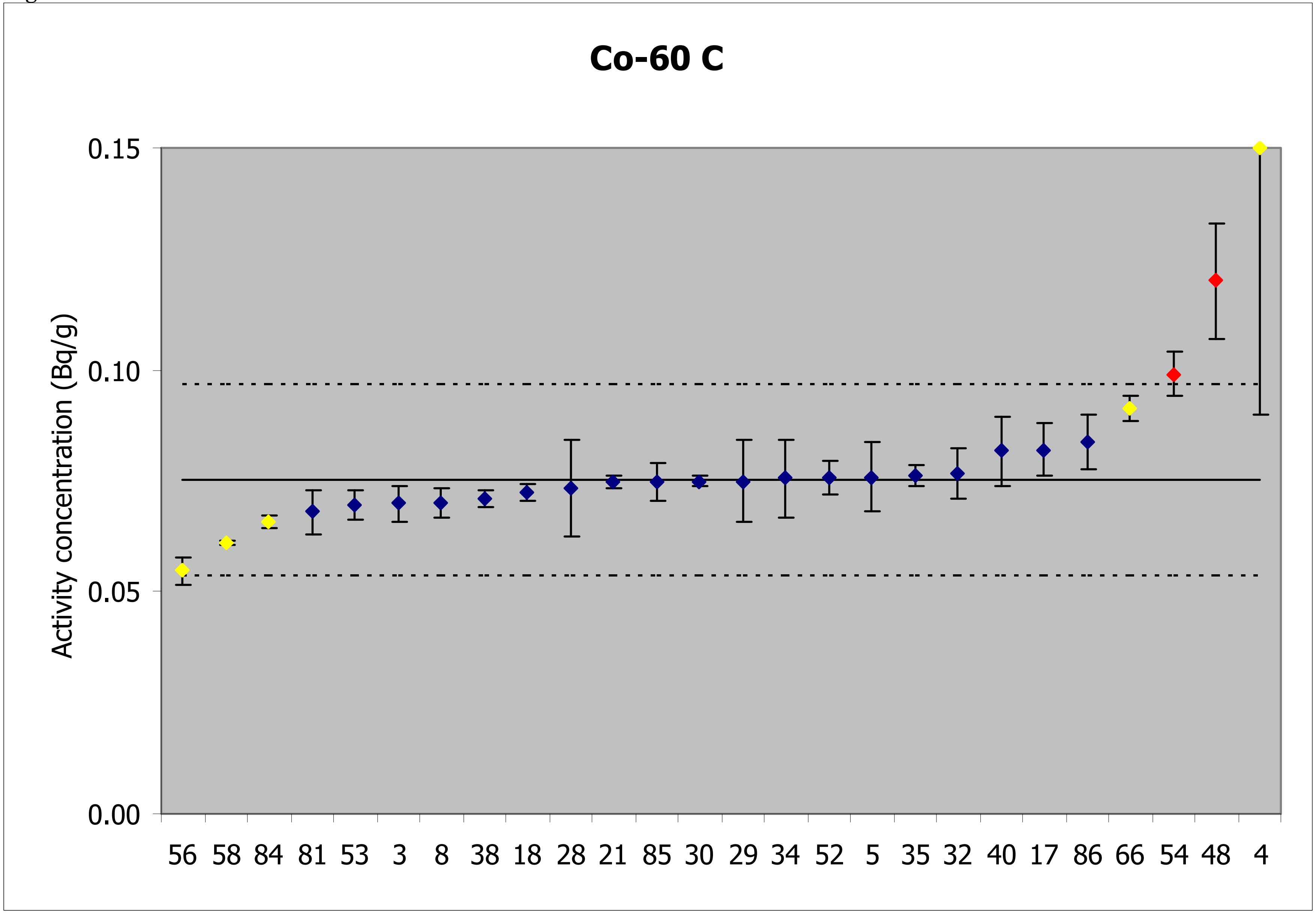


Figure 62B – Relative uncertainty Co-60 C

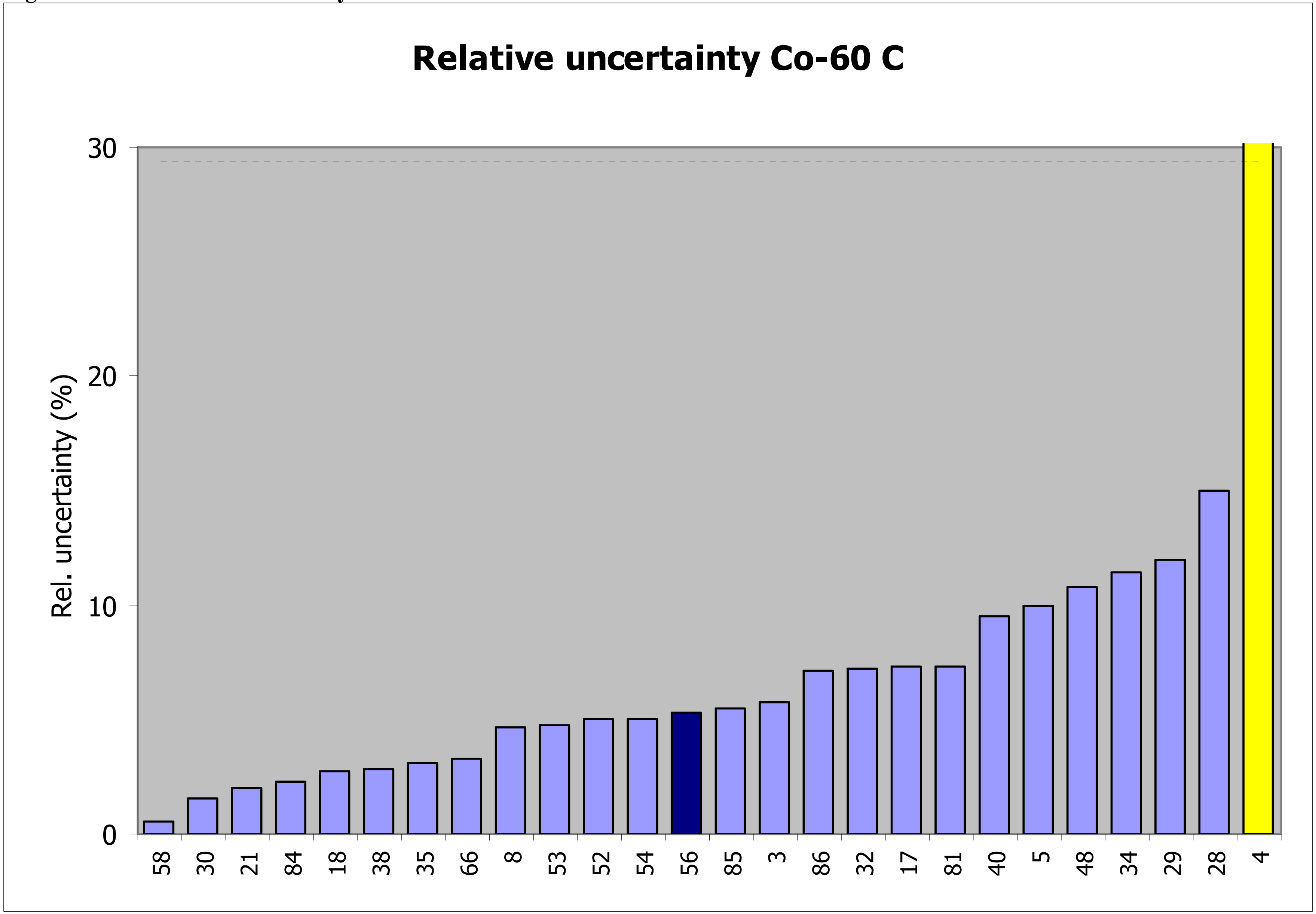


Figure 62C – Kiri plot Co-60 C

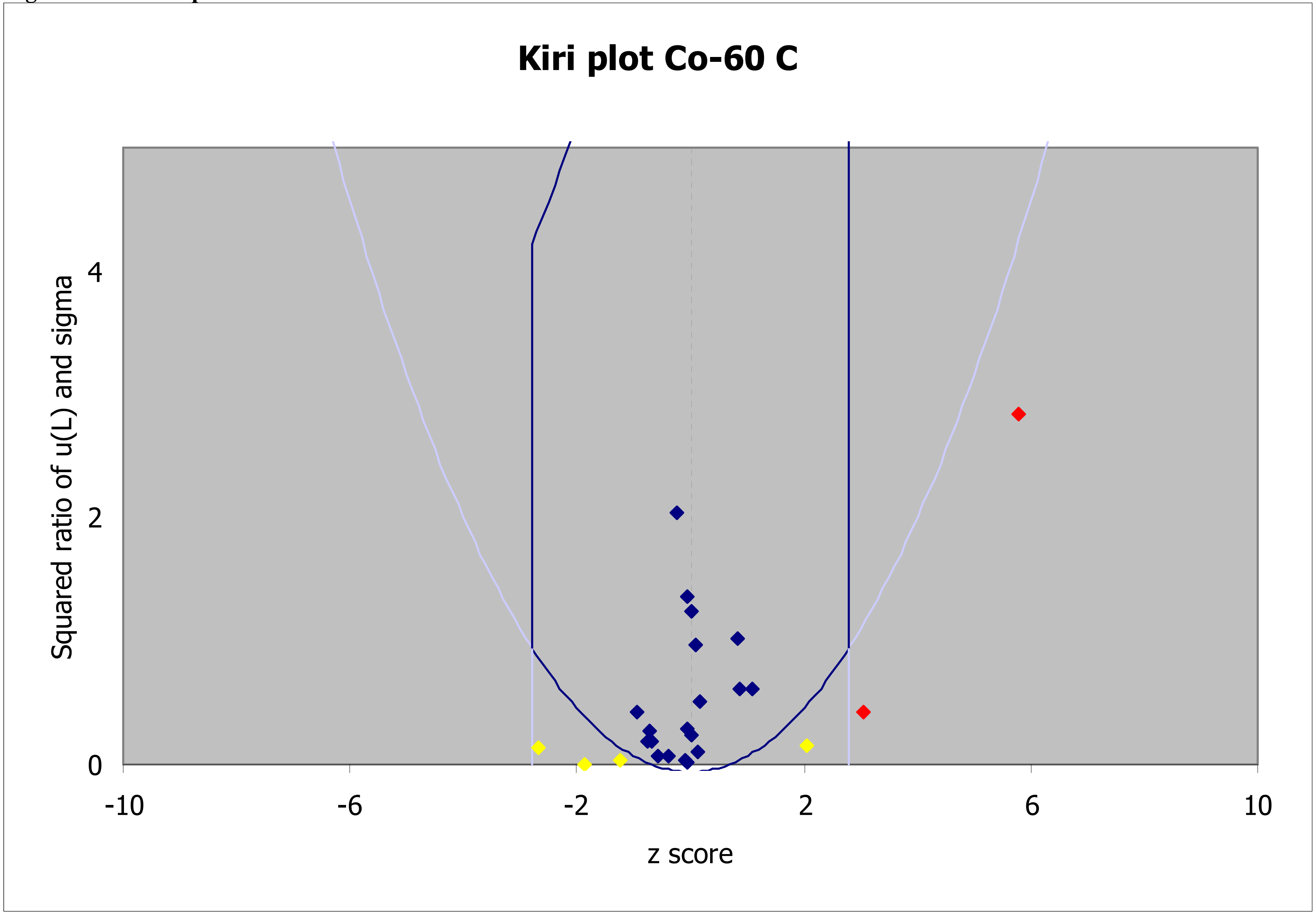


Figure 63 – Ni-63 C

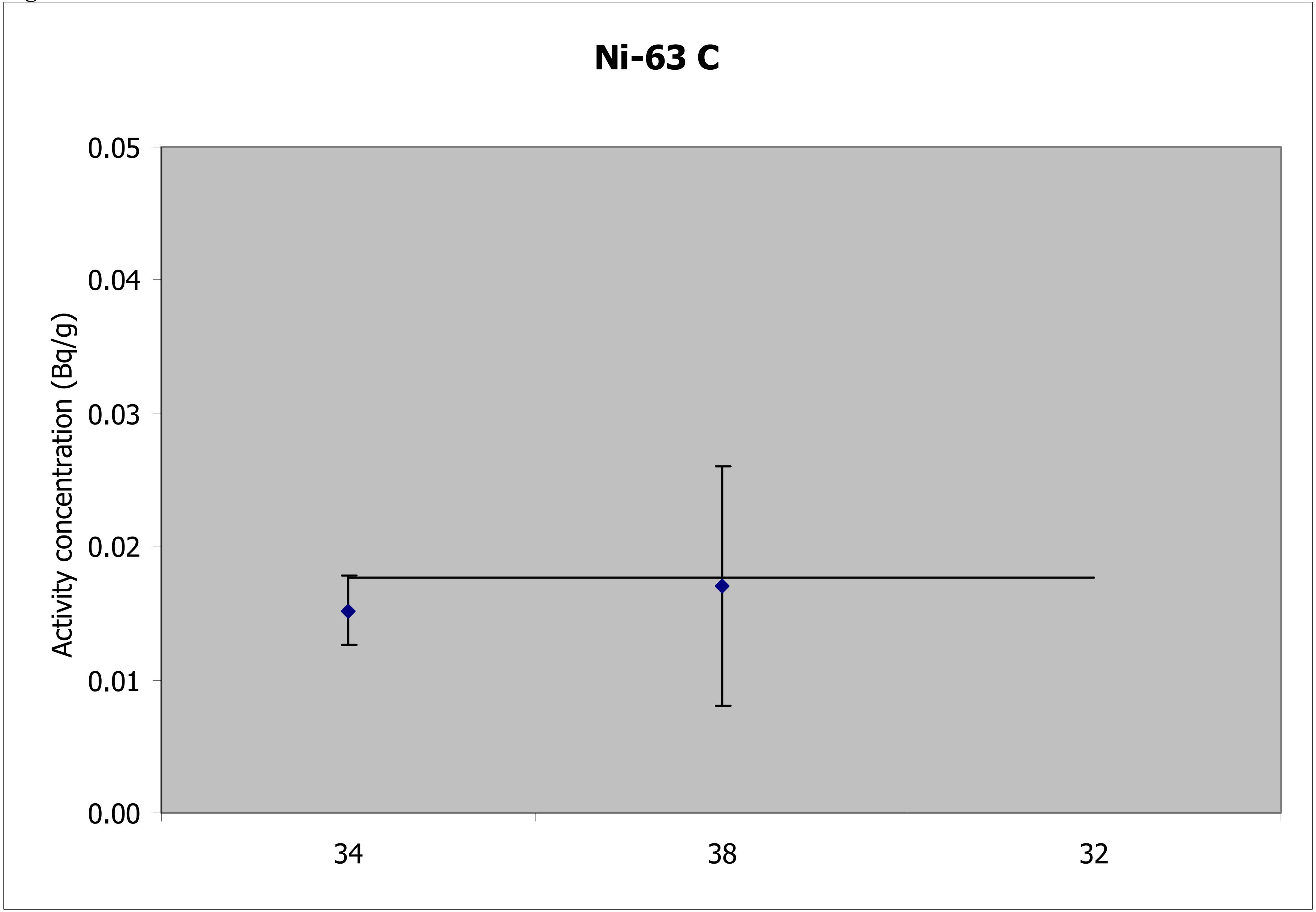


Figure 64A – Ba-133 C

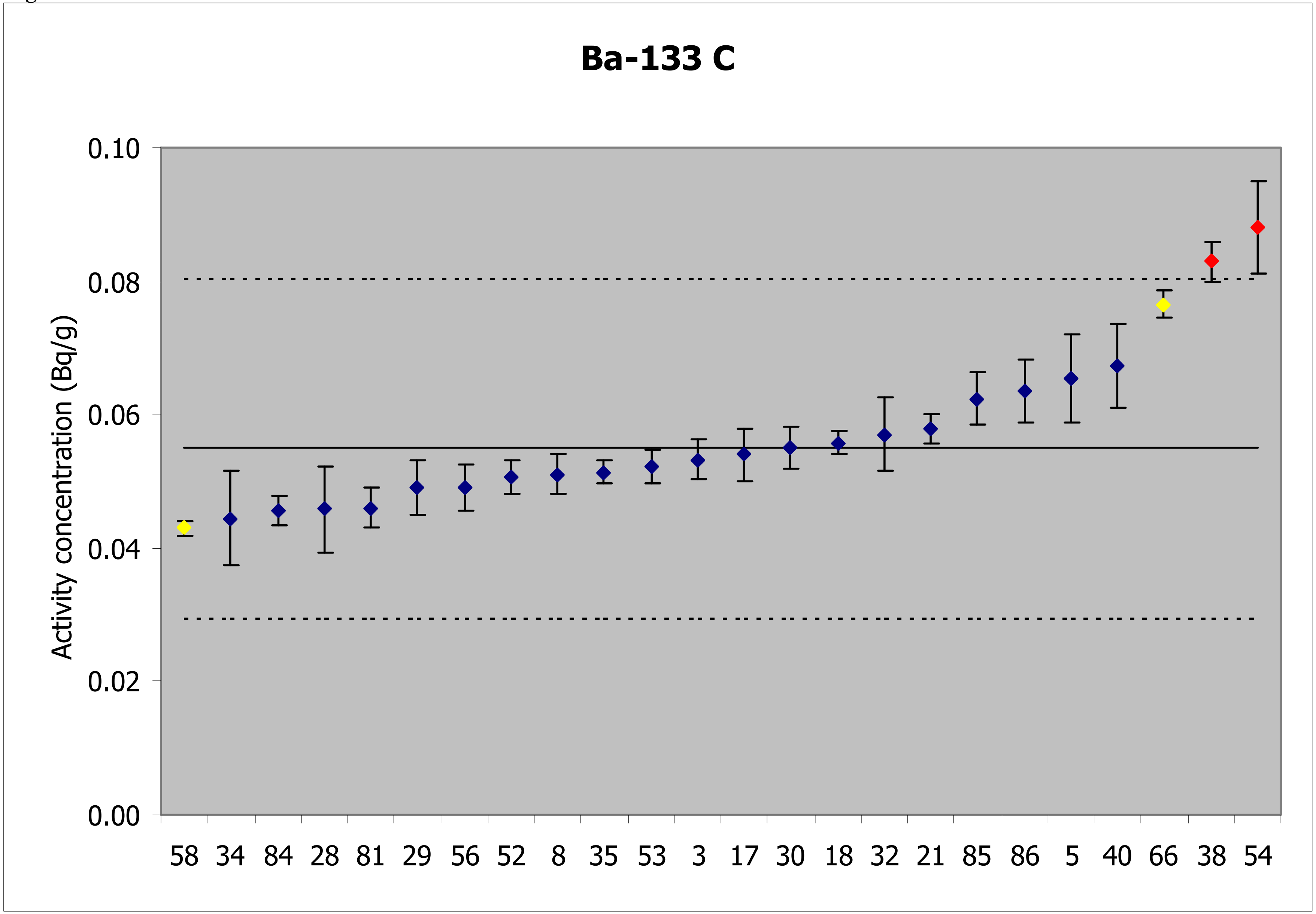


Figure 64B – Relative uncertainty Ba-133 C

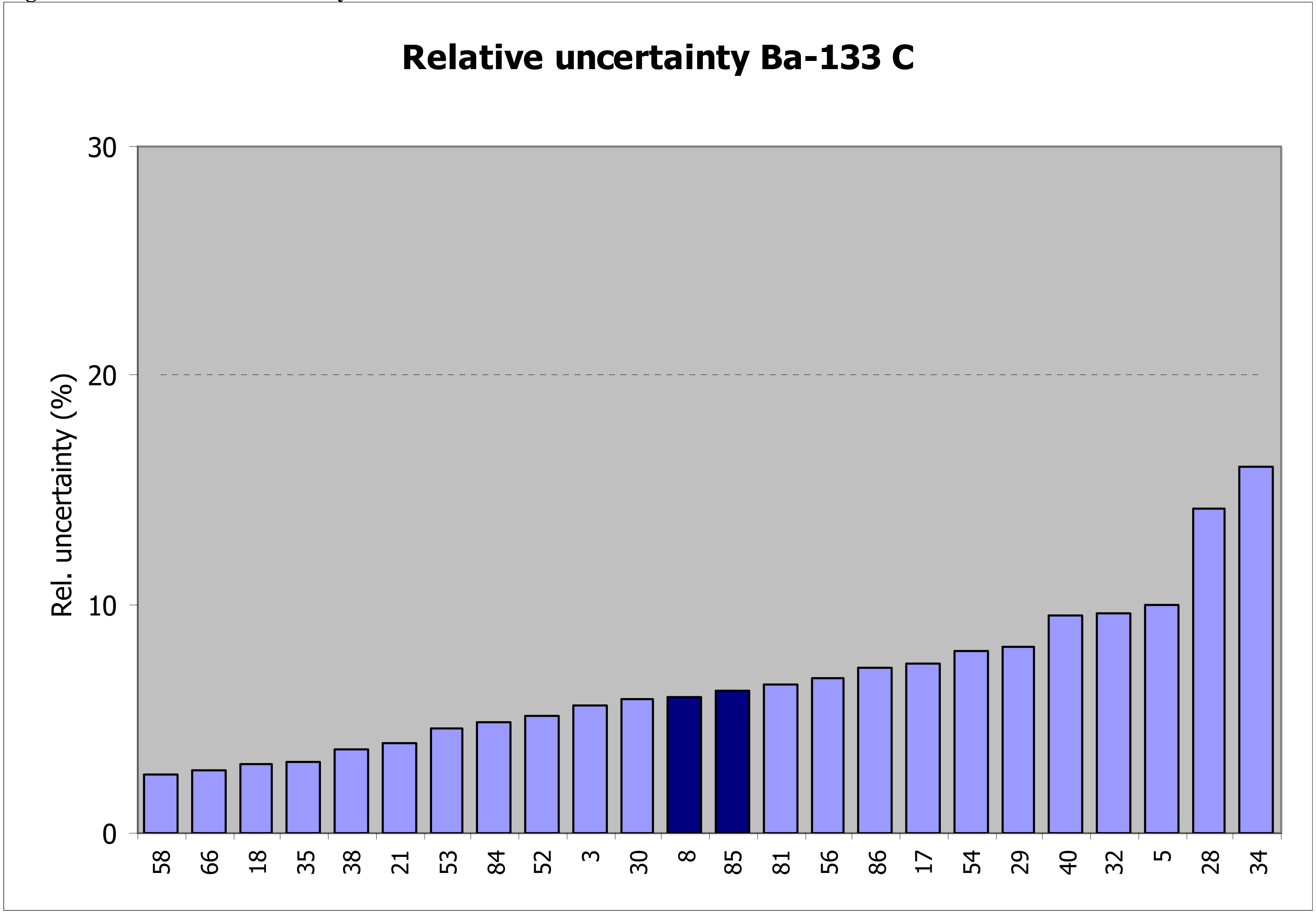


Figure 64C – Kiri plot Ba-133 C

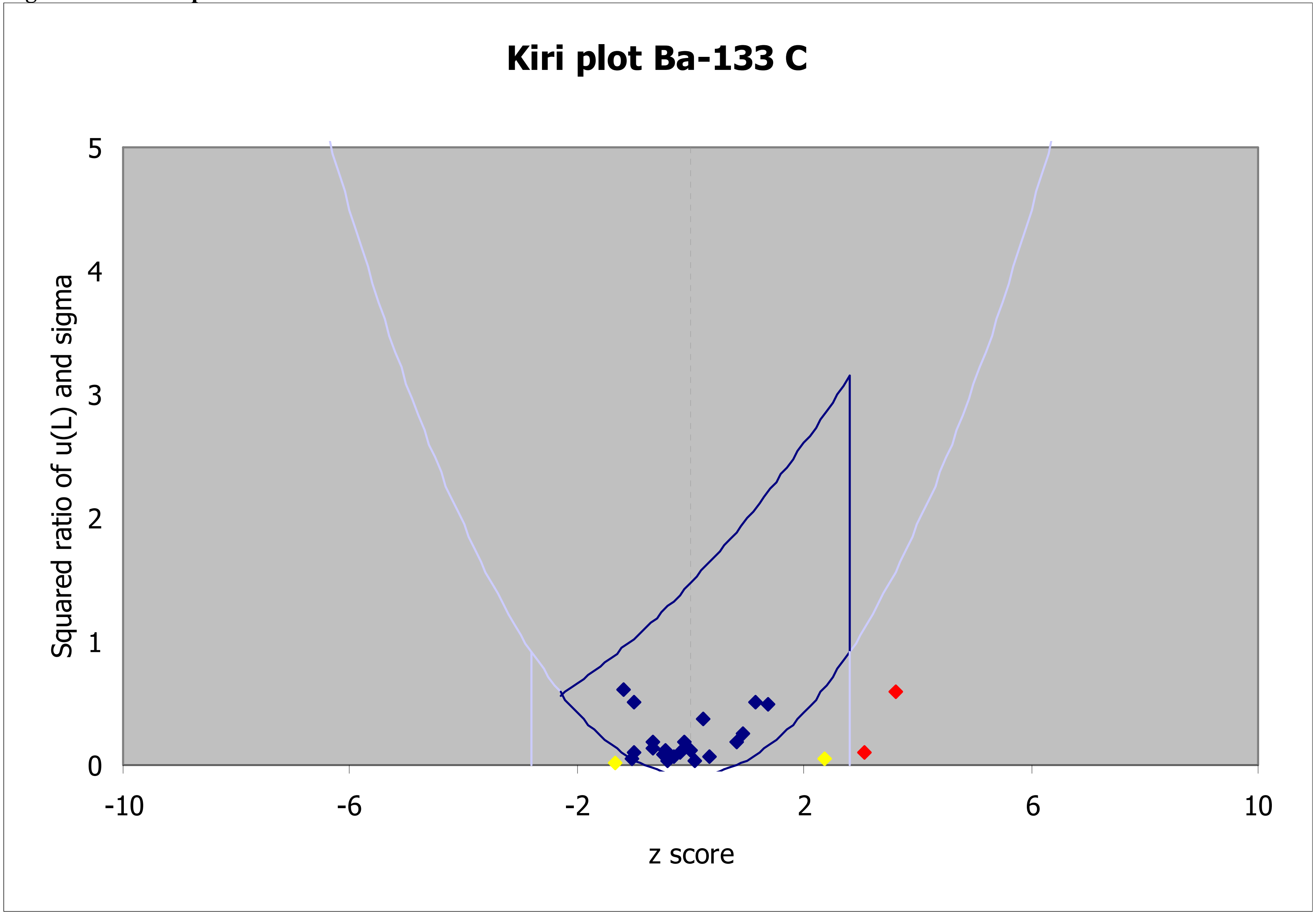


Figure 65 – Cs-137 C

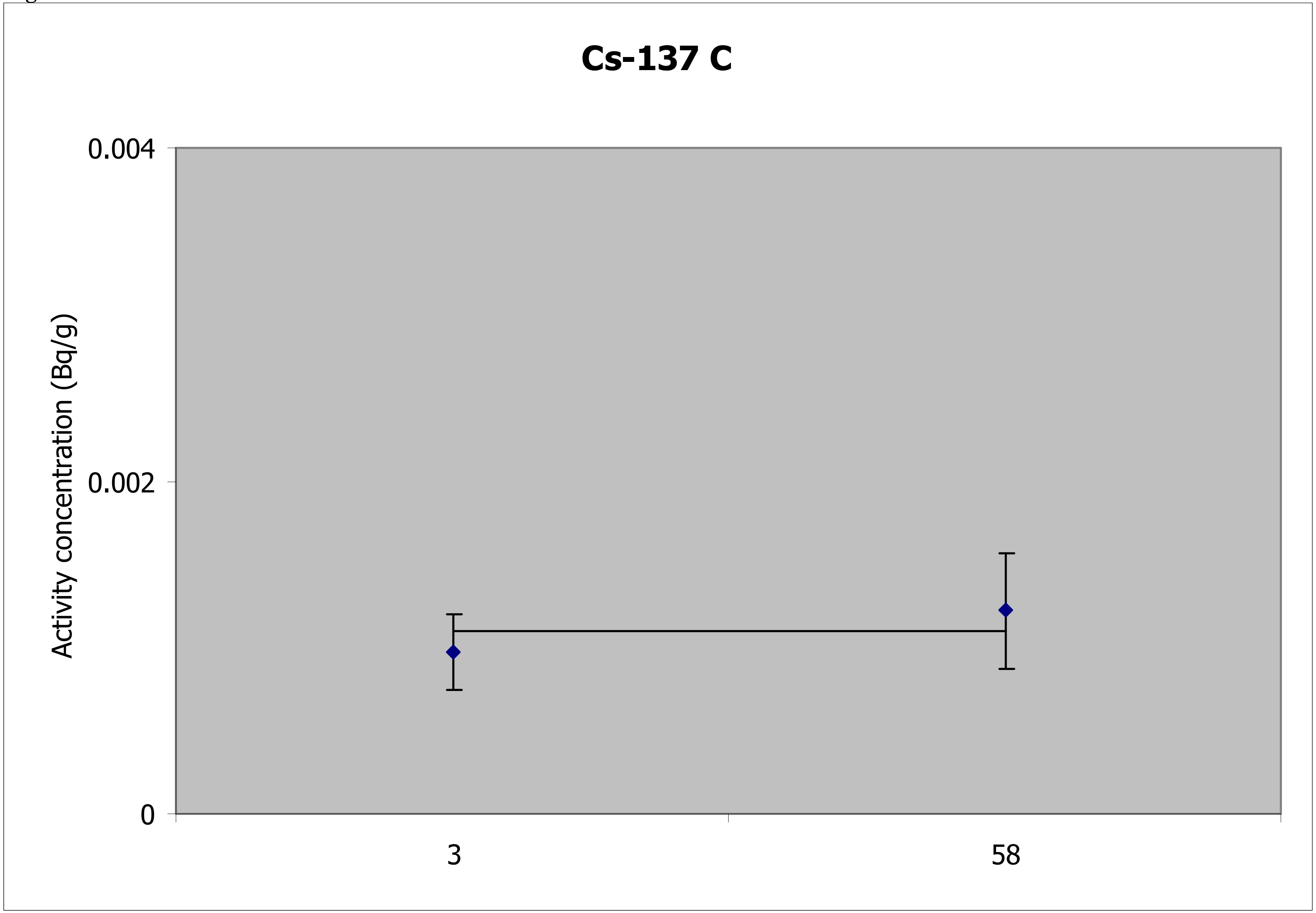


Figure 66A – Eu-152 C

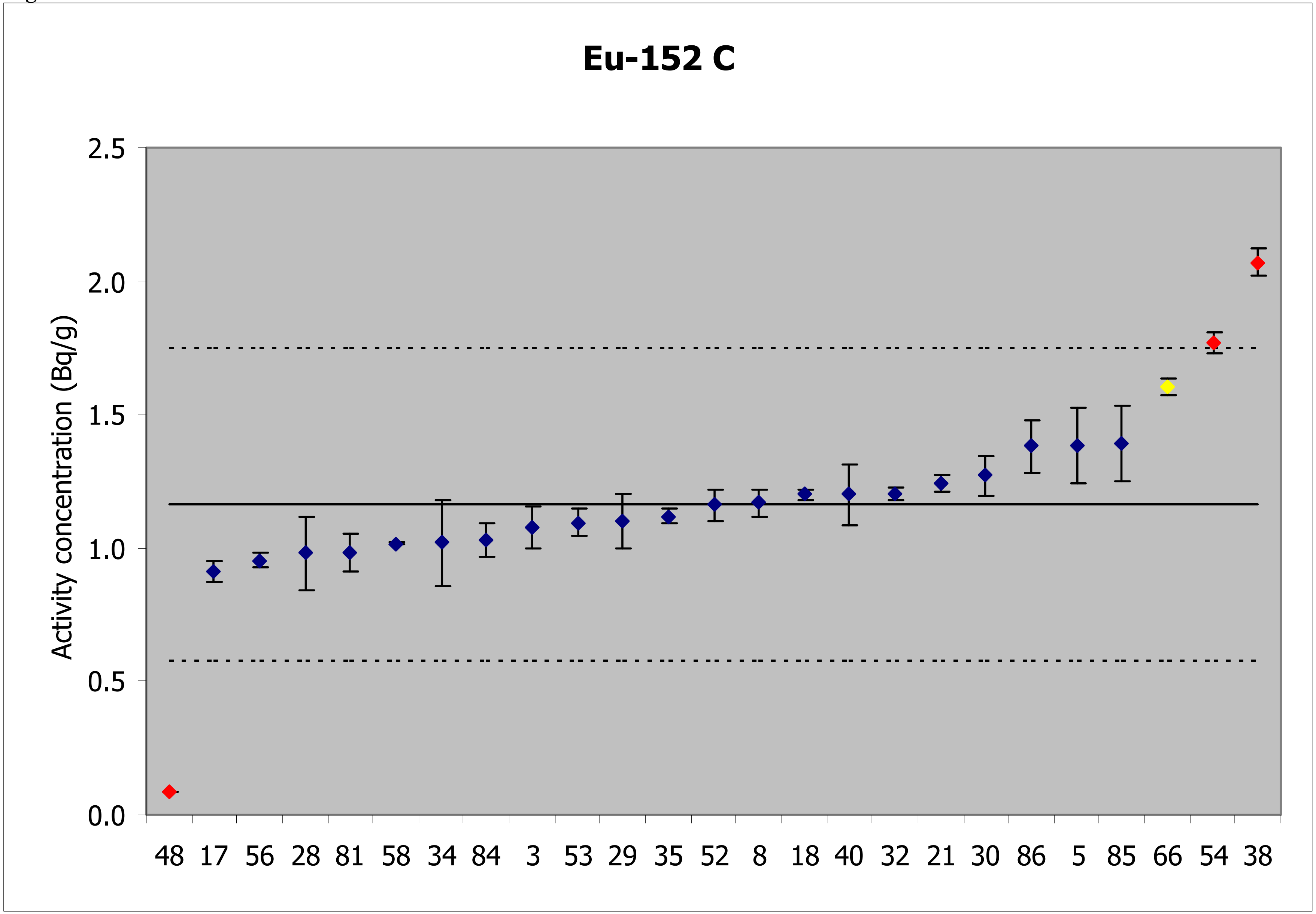


Figure 66B – Relative uncertainty Eu-152 C

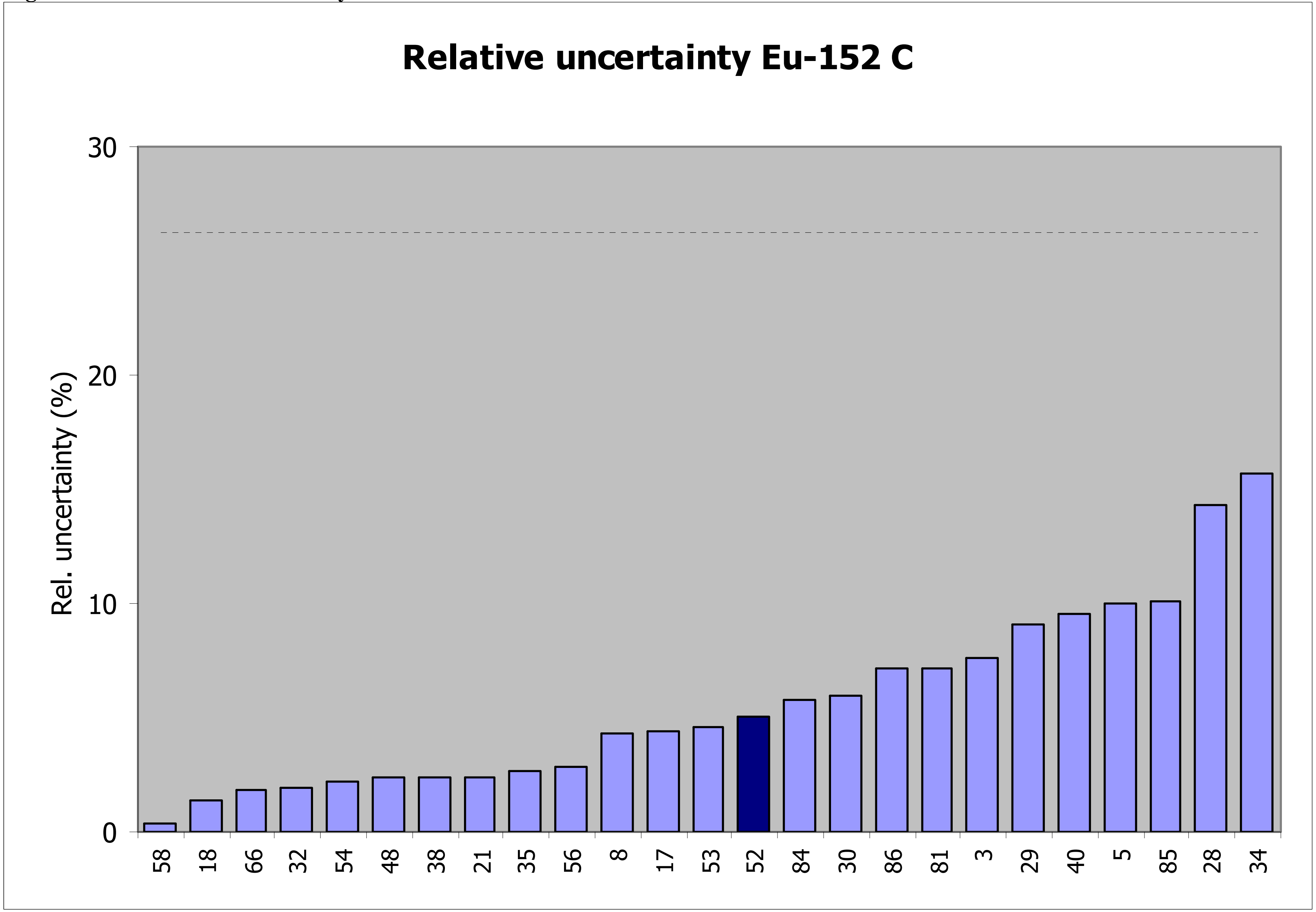


Figure 66C – Kiri plot Eu-152 C

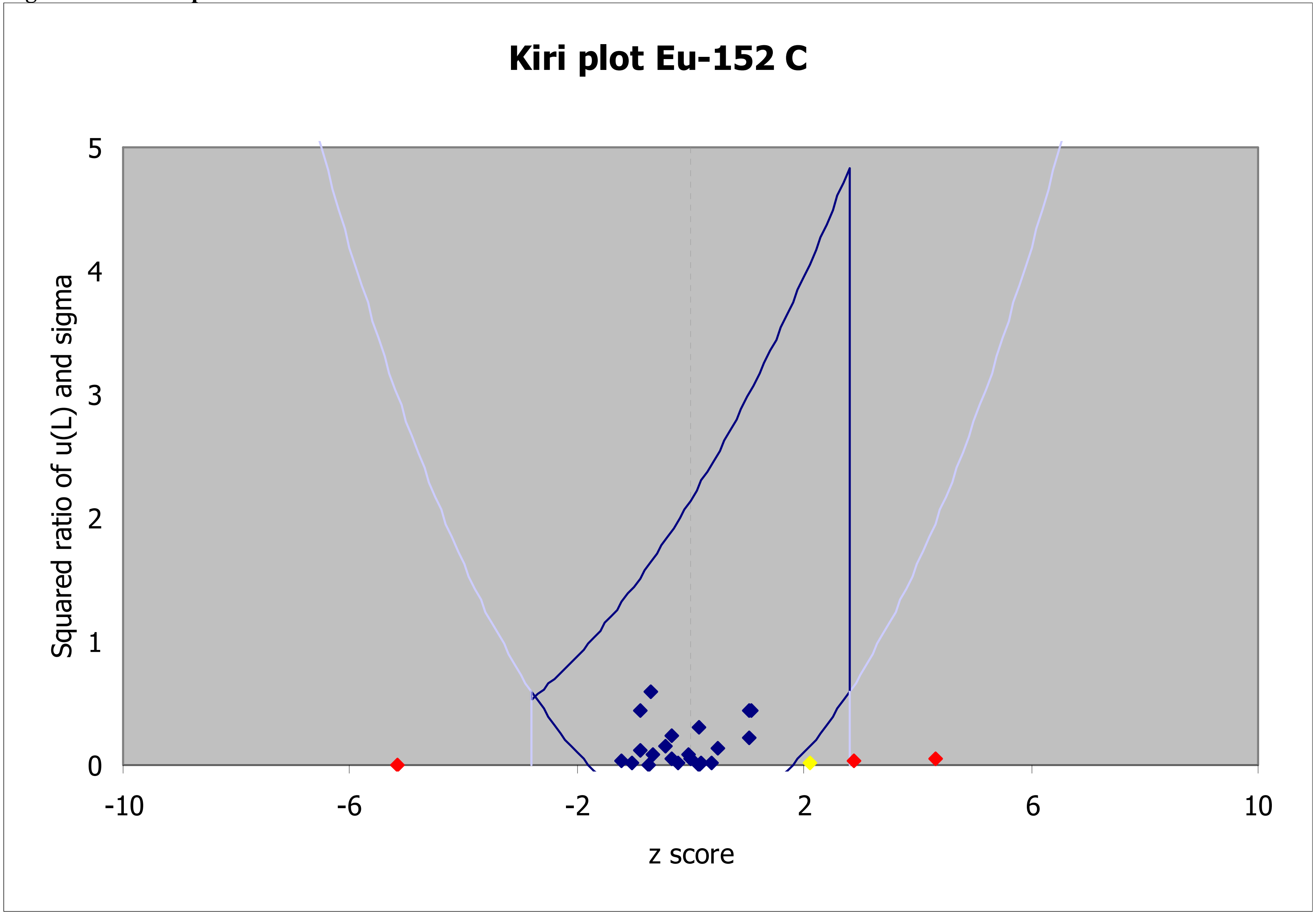


Figure 67A – Eu-154 C

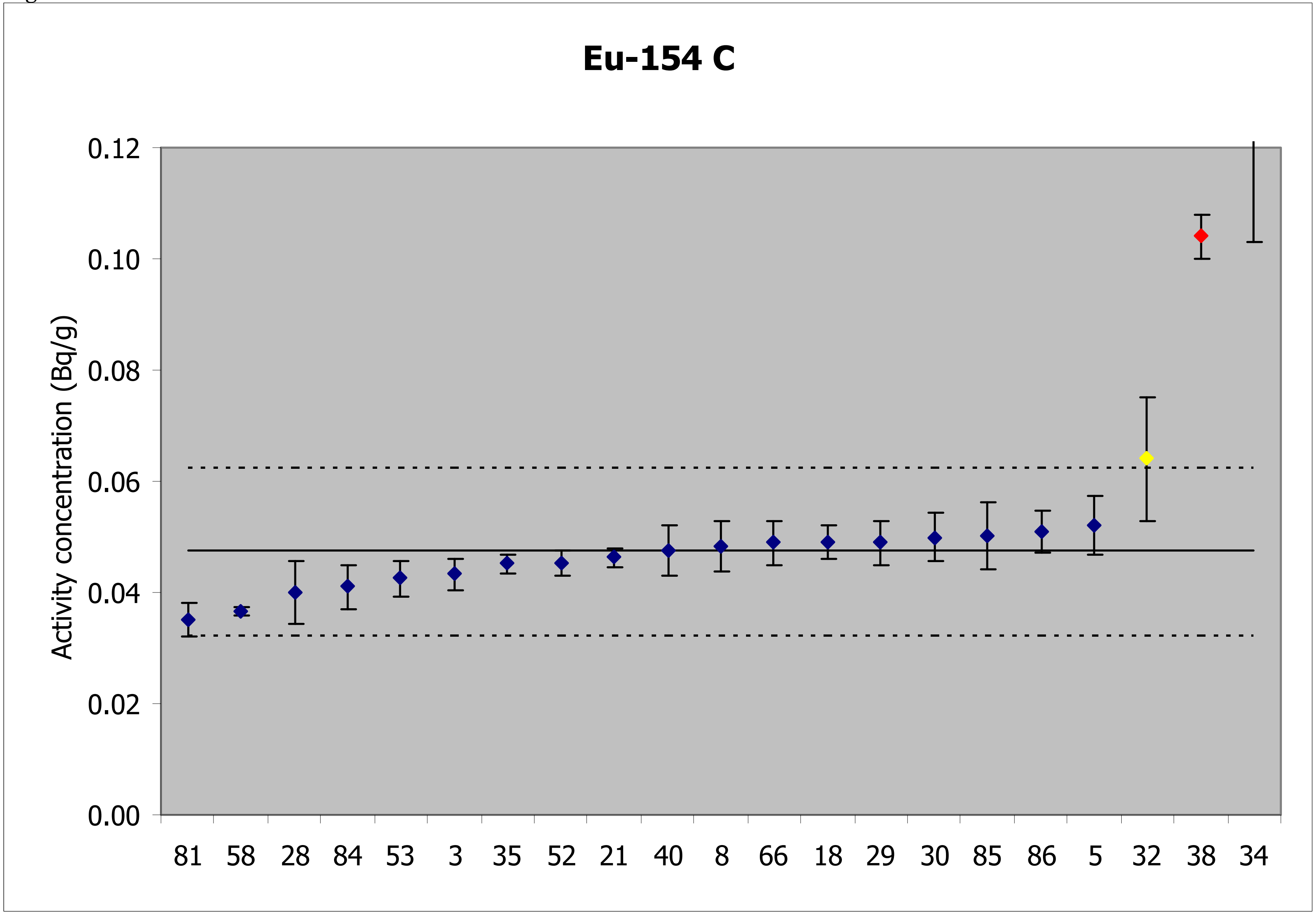


Figure 67B – Relative uncertainty Eu-154 C

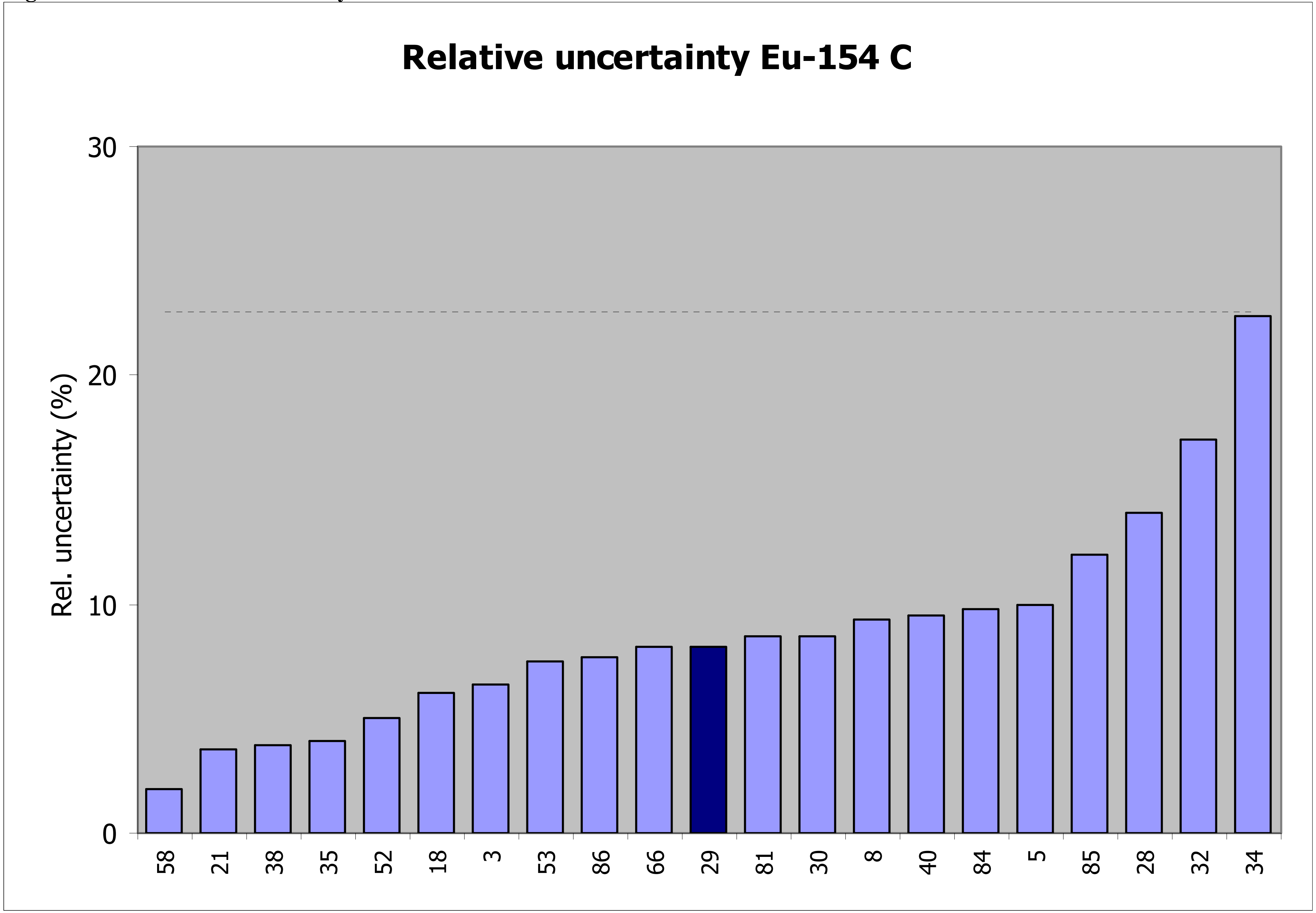


Figure 67C – Kiri plot Eu-154 C

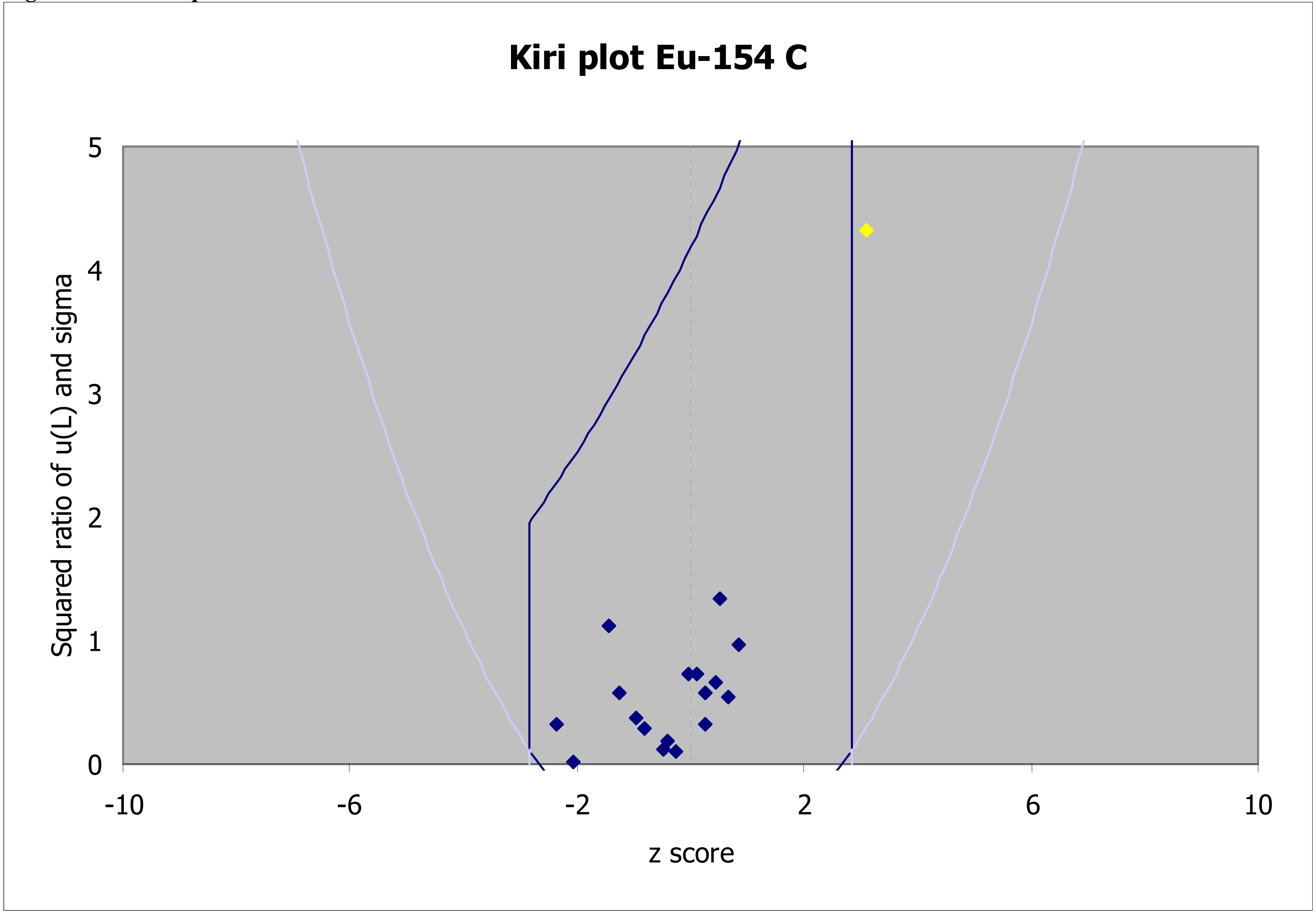


Figure 68 – Ra-226 C

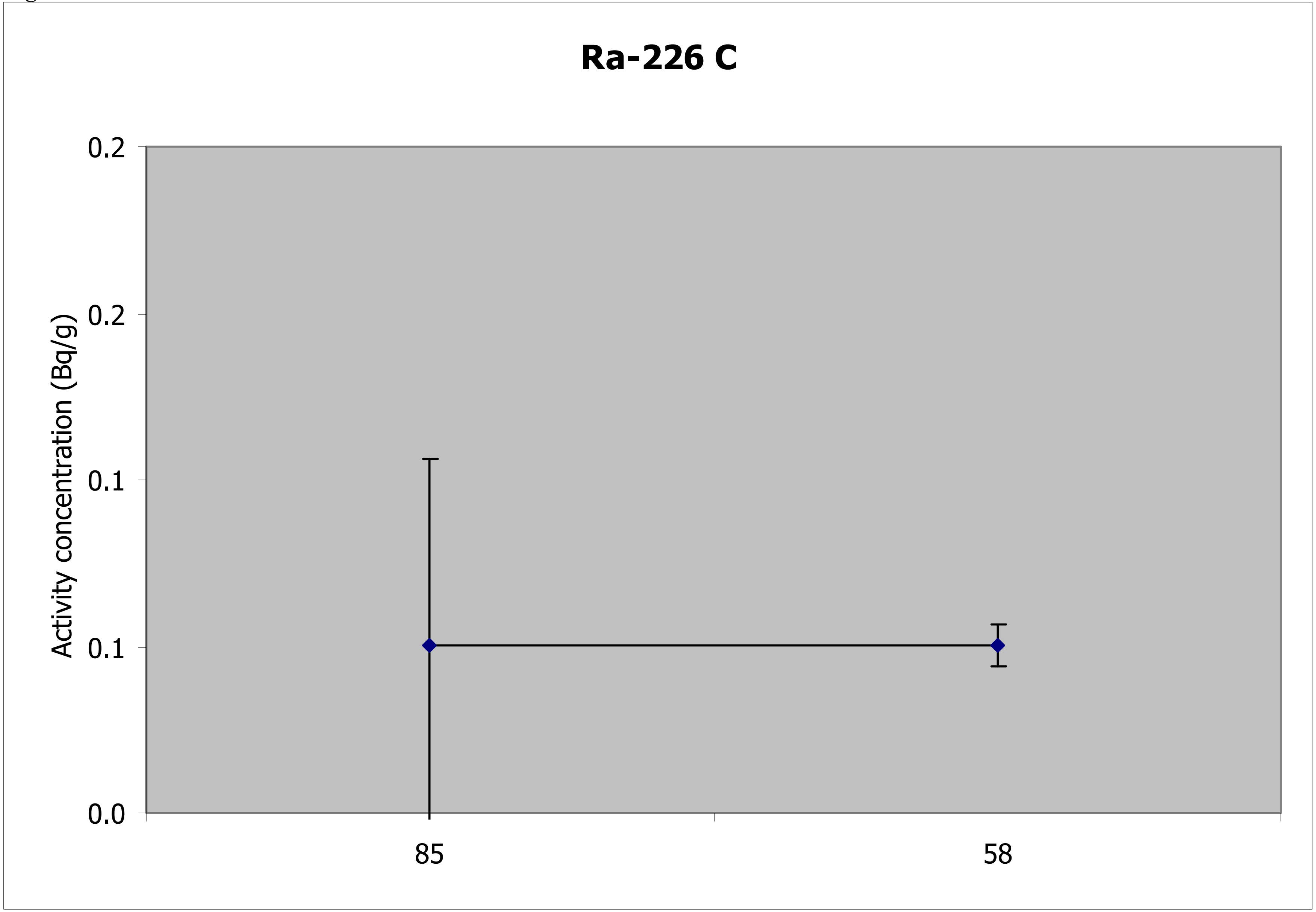


Figure 69 – Ra-228 C

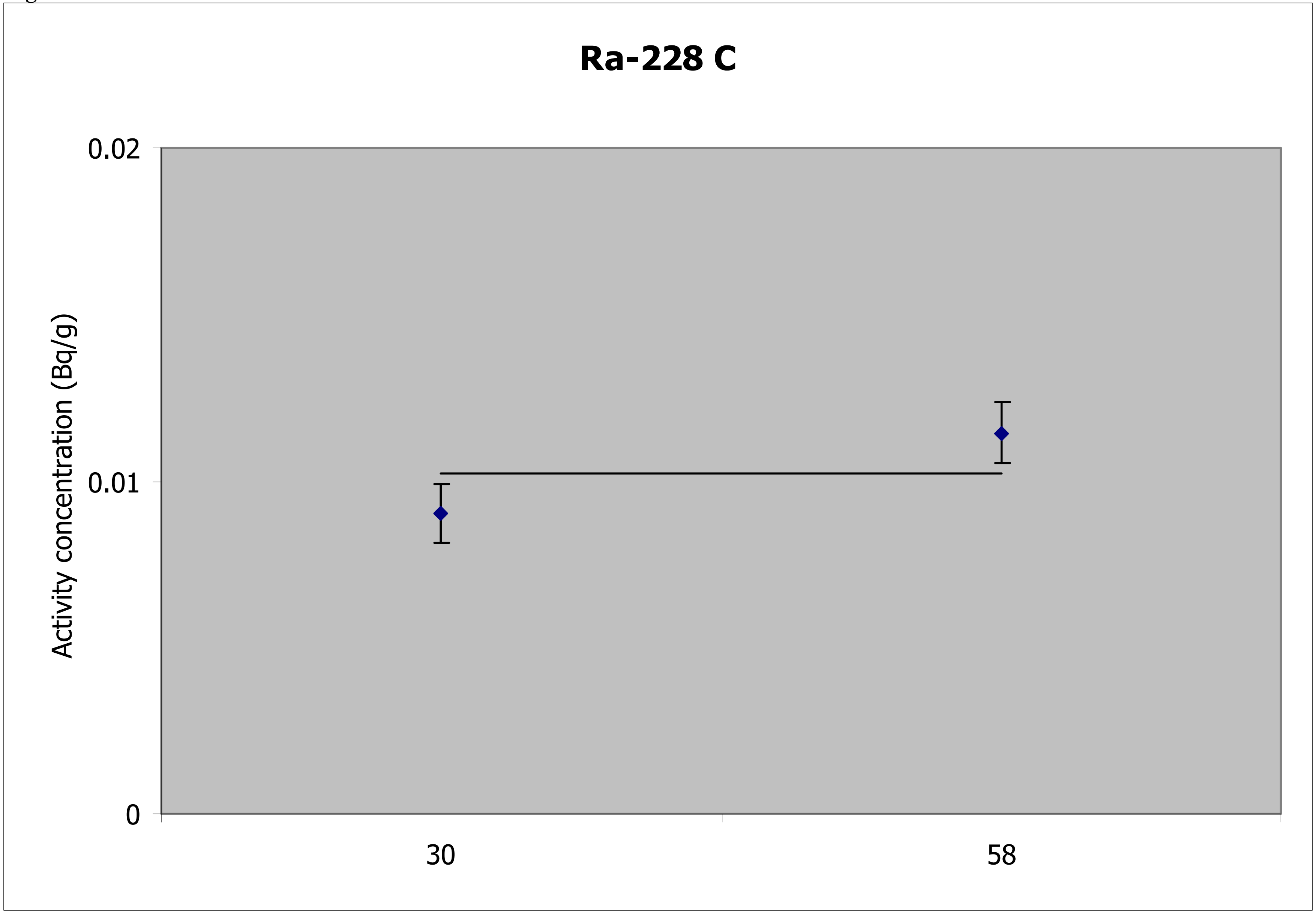


Figure 70A – Homogeneity test Co-60 C

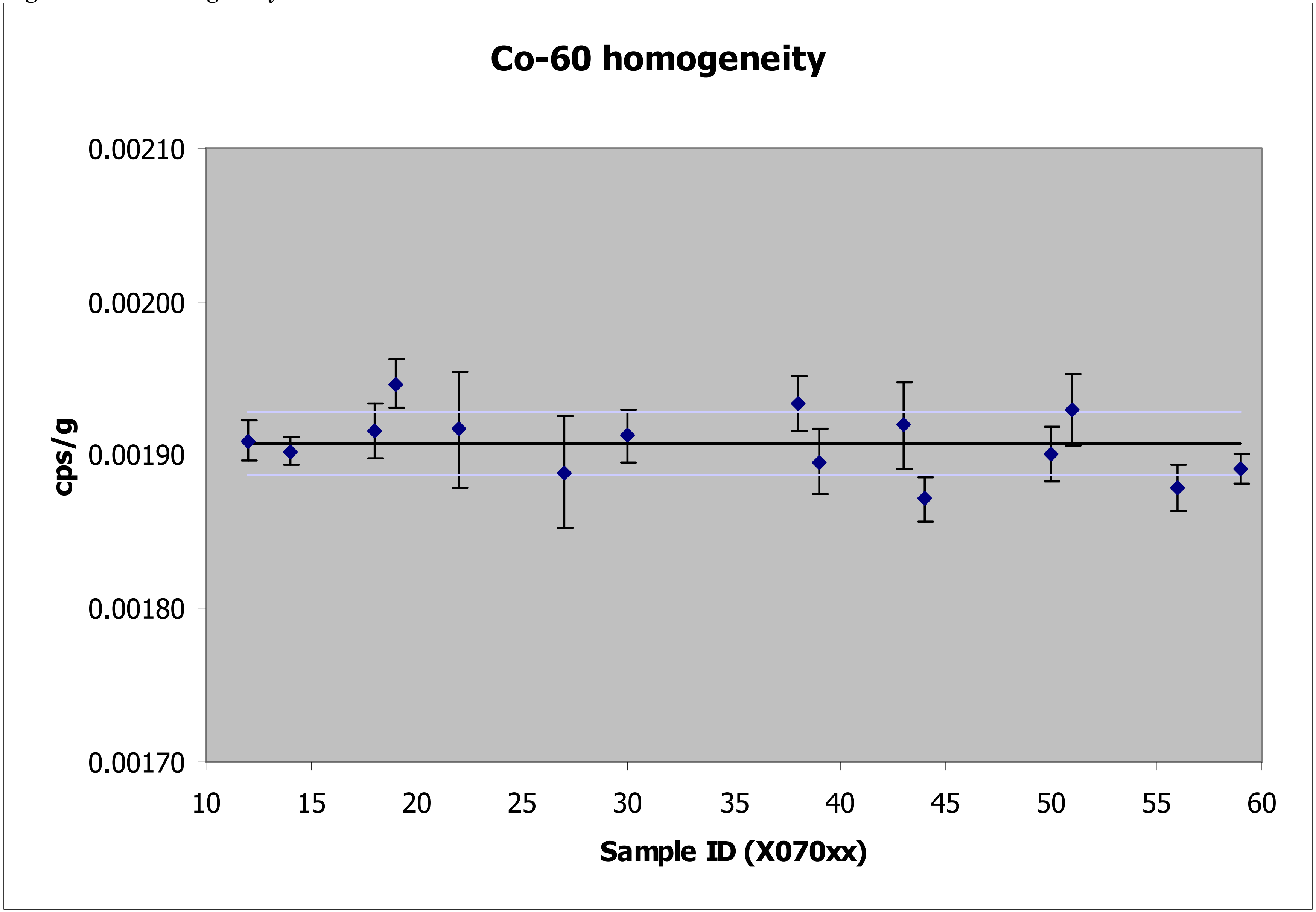


Figure 70B – Homogeneity test Ba-133 C

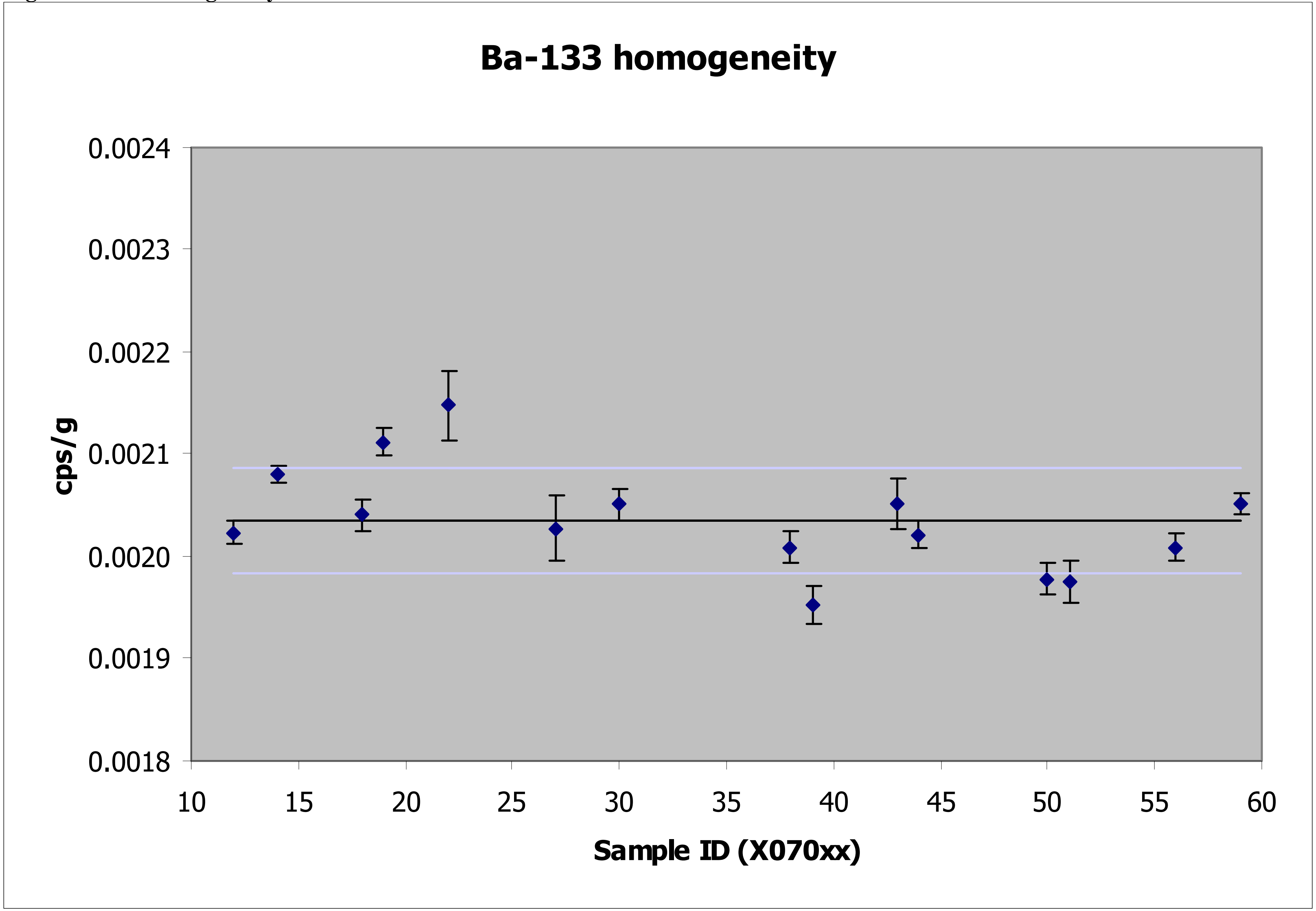


Figure 70C – Homogeneity test Eu-152 C

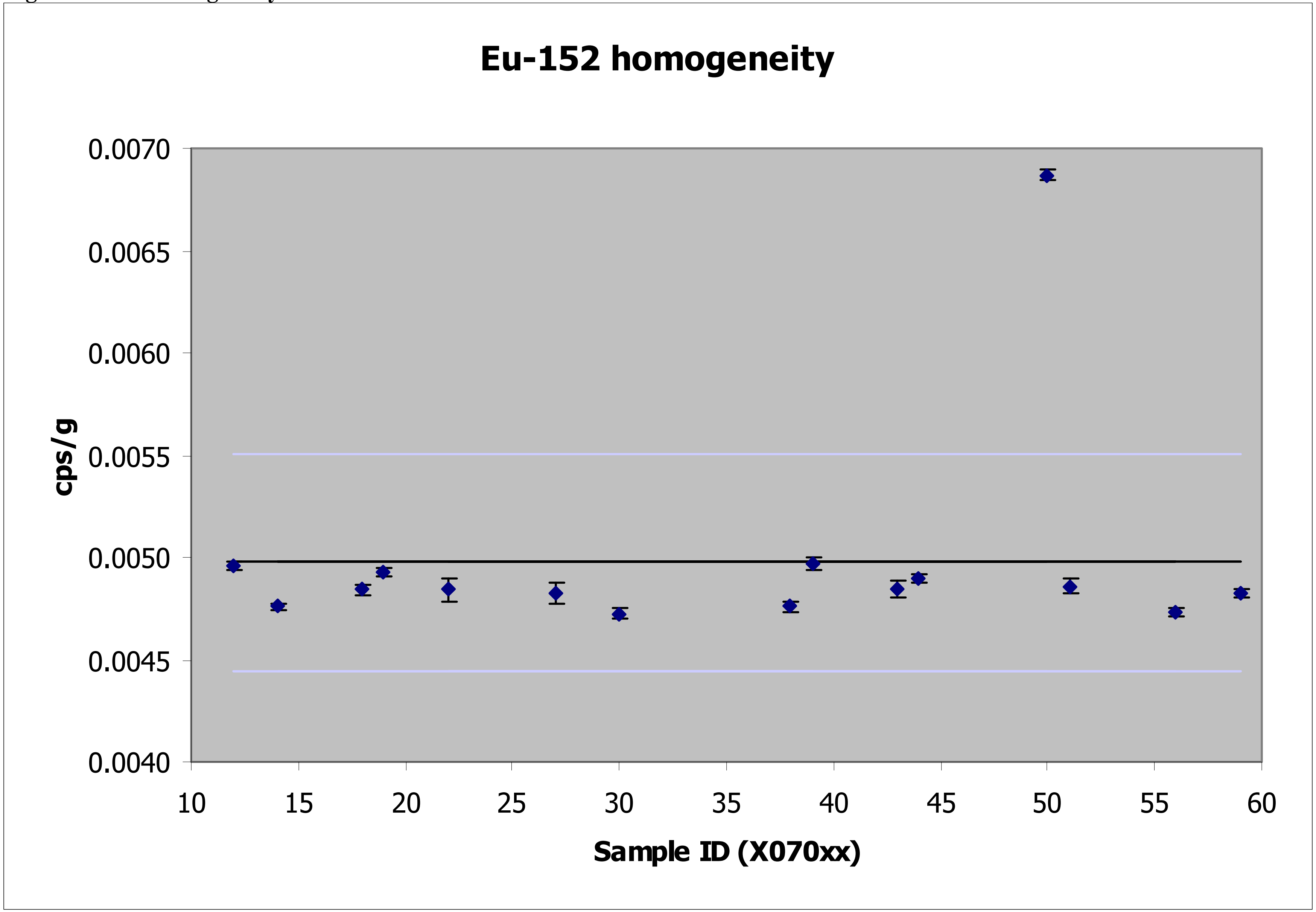


Figure 70D – Homogeneity test Eu-154 C

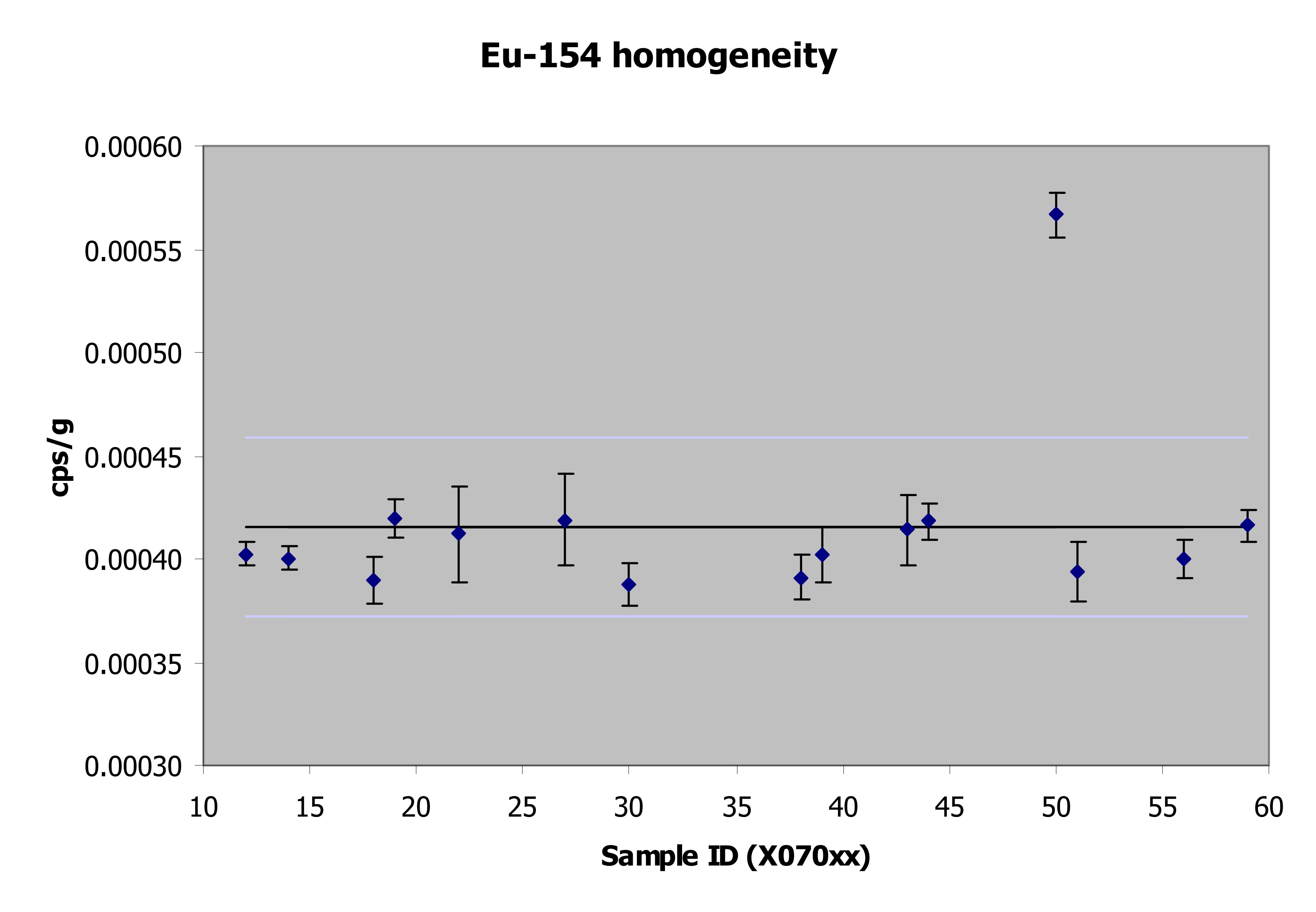


Figure 71 – Laboratory 3

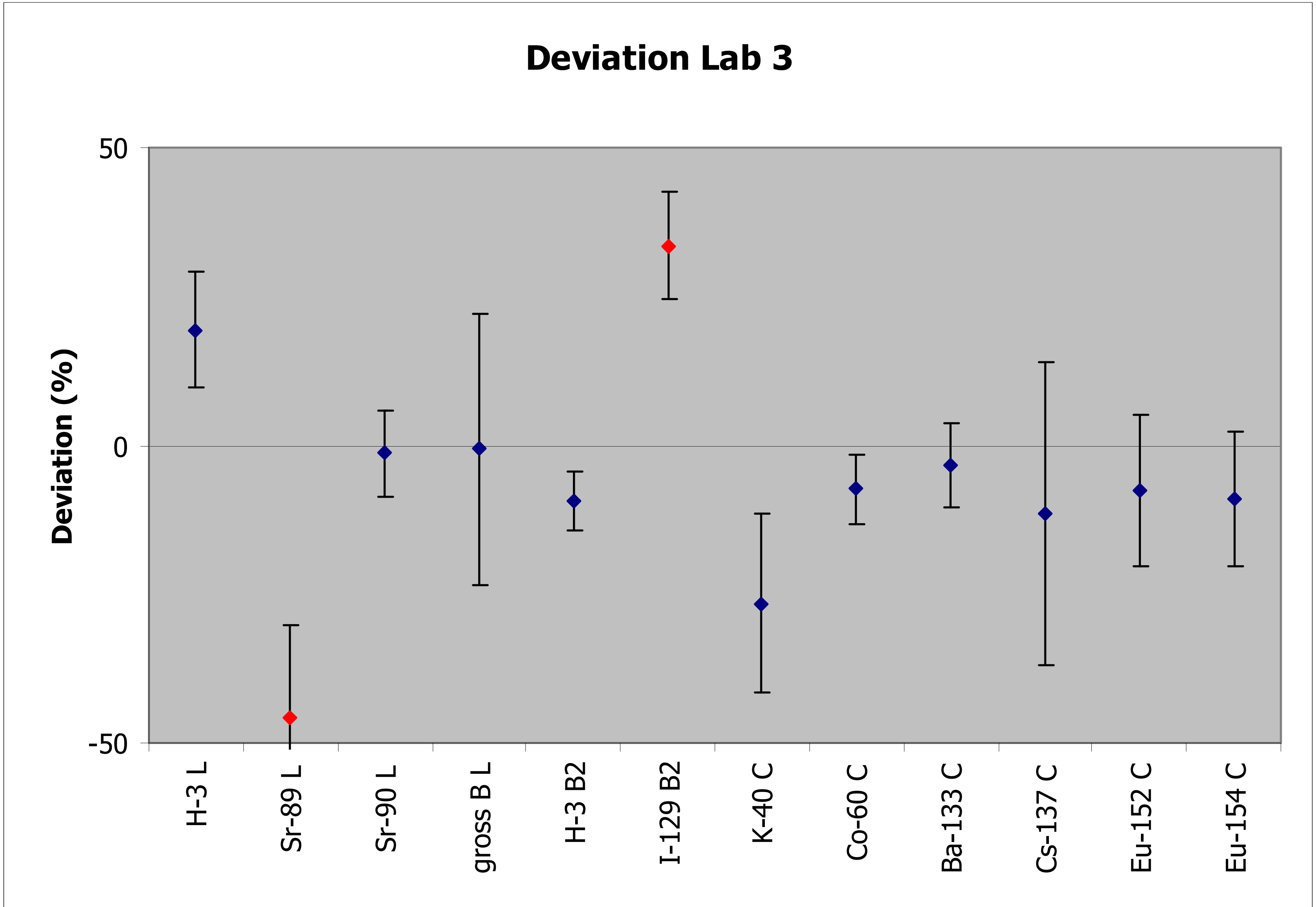


Figure 72 – Laboratory 4

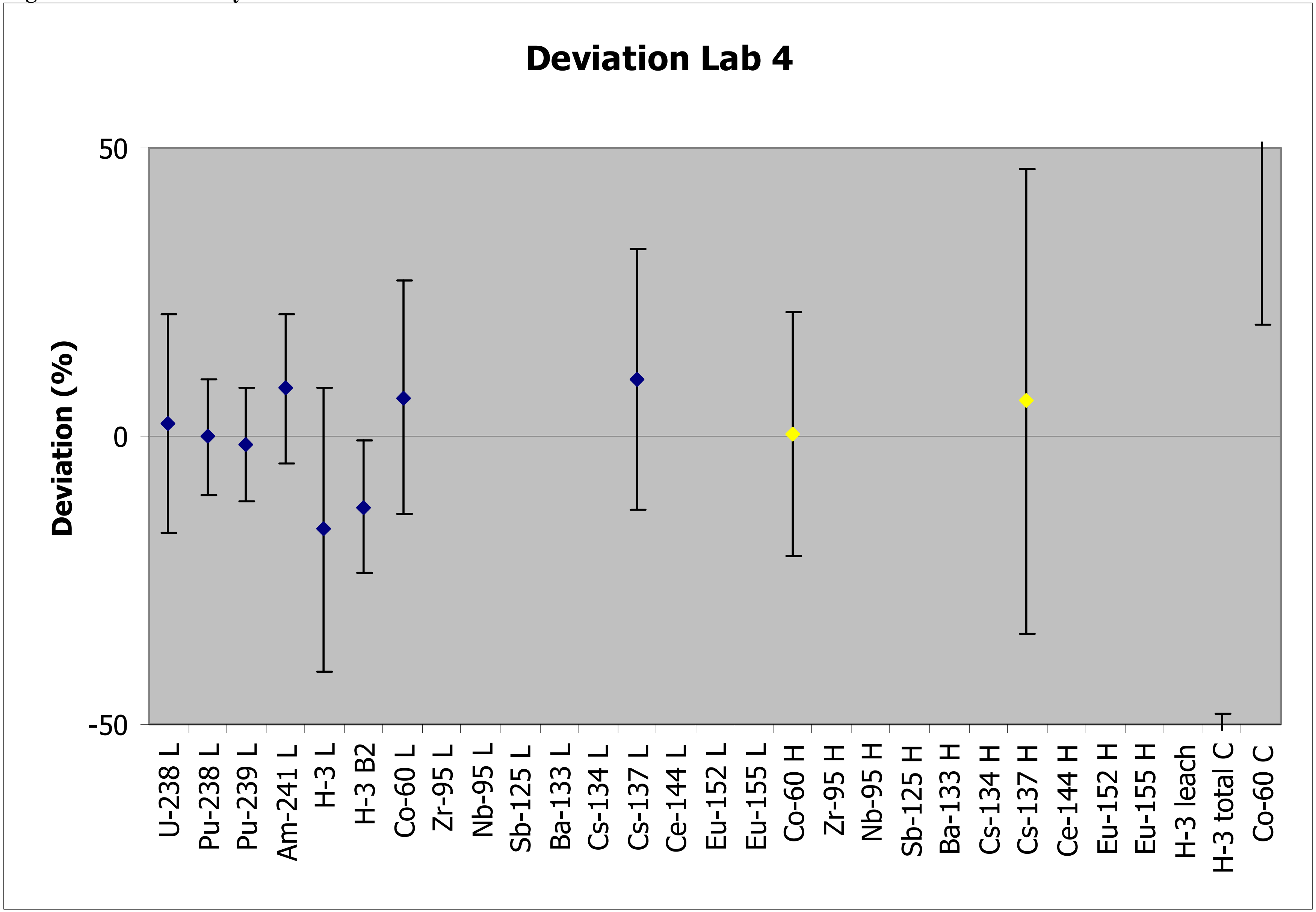


Figure 73 – Laboratory 5

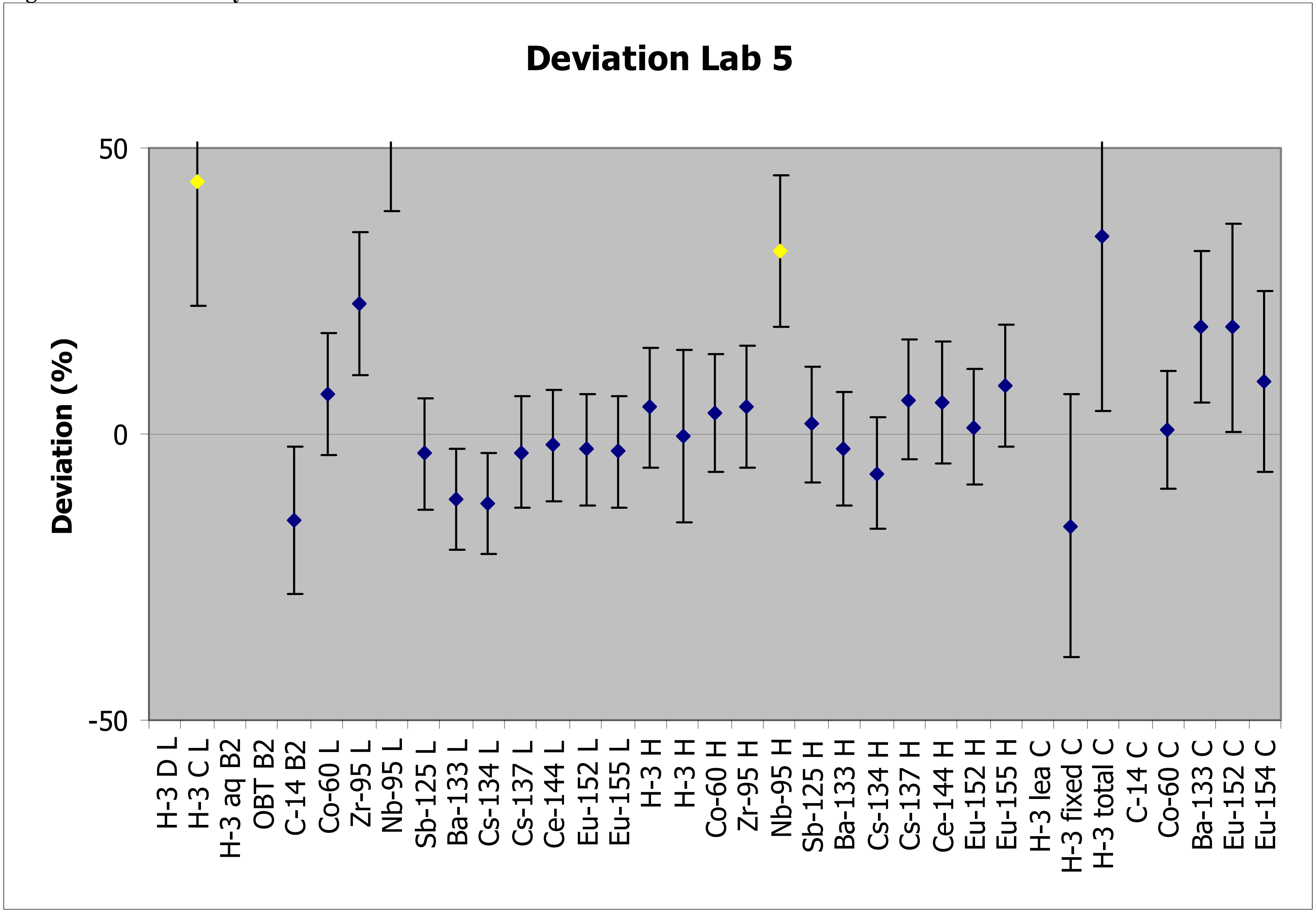


Figure 74 – Laboratory 7

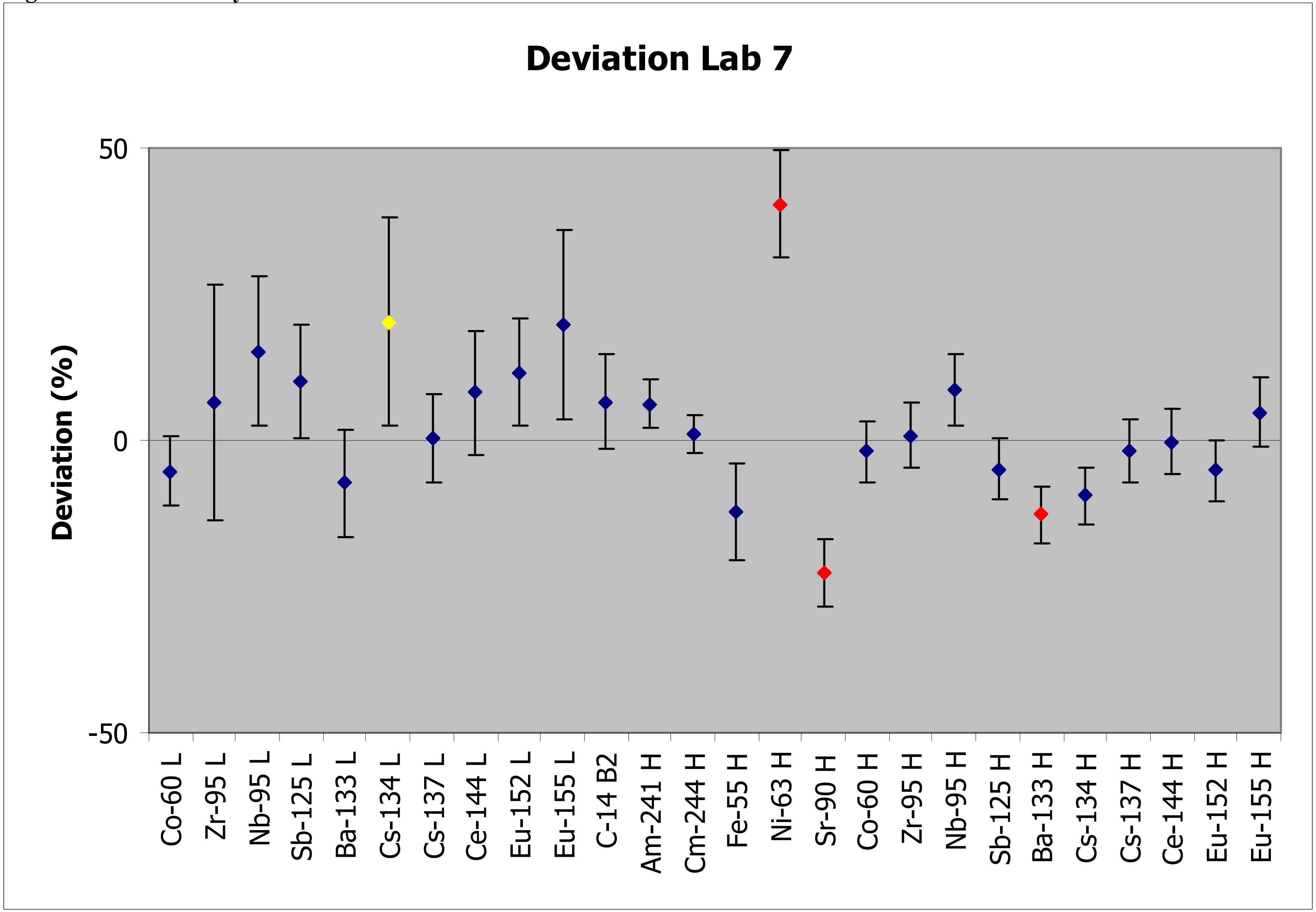


Figure 75 – Laboratory 8

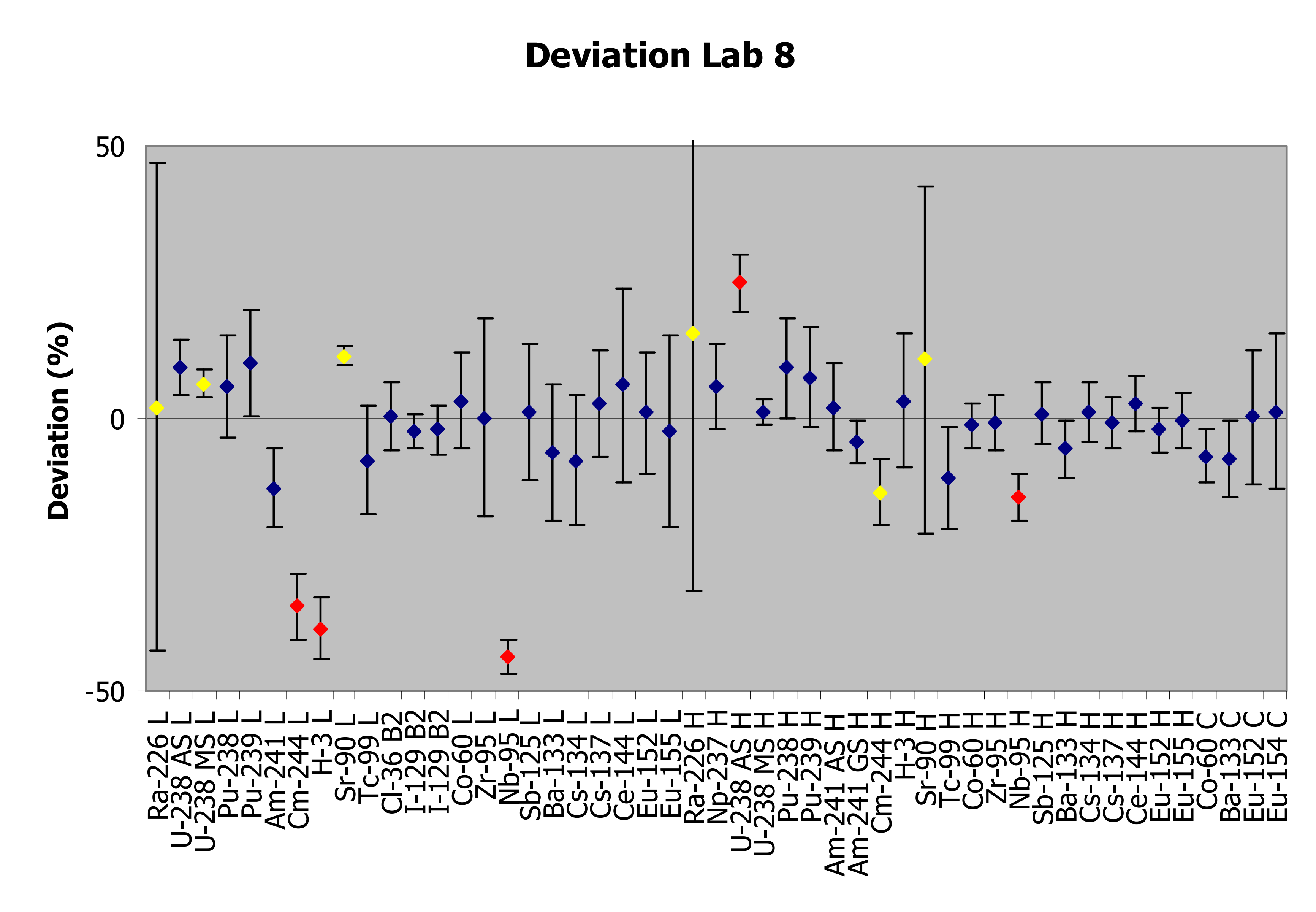


Figure 76 – Laboratory 9

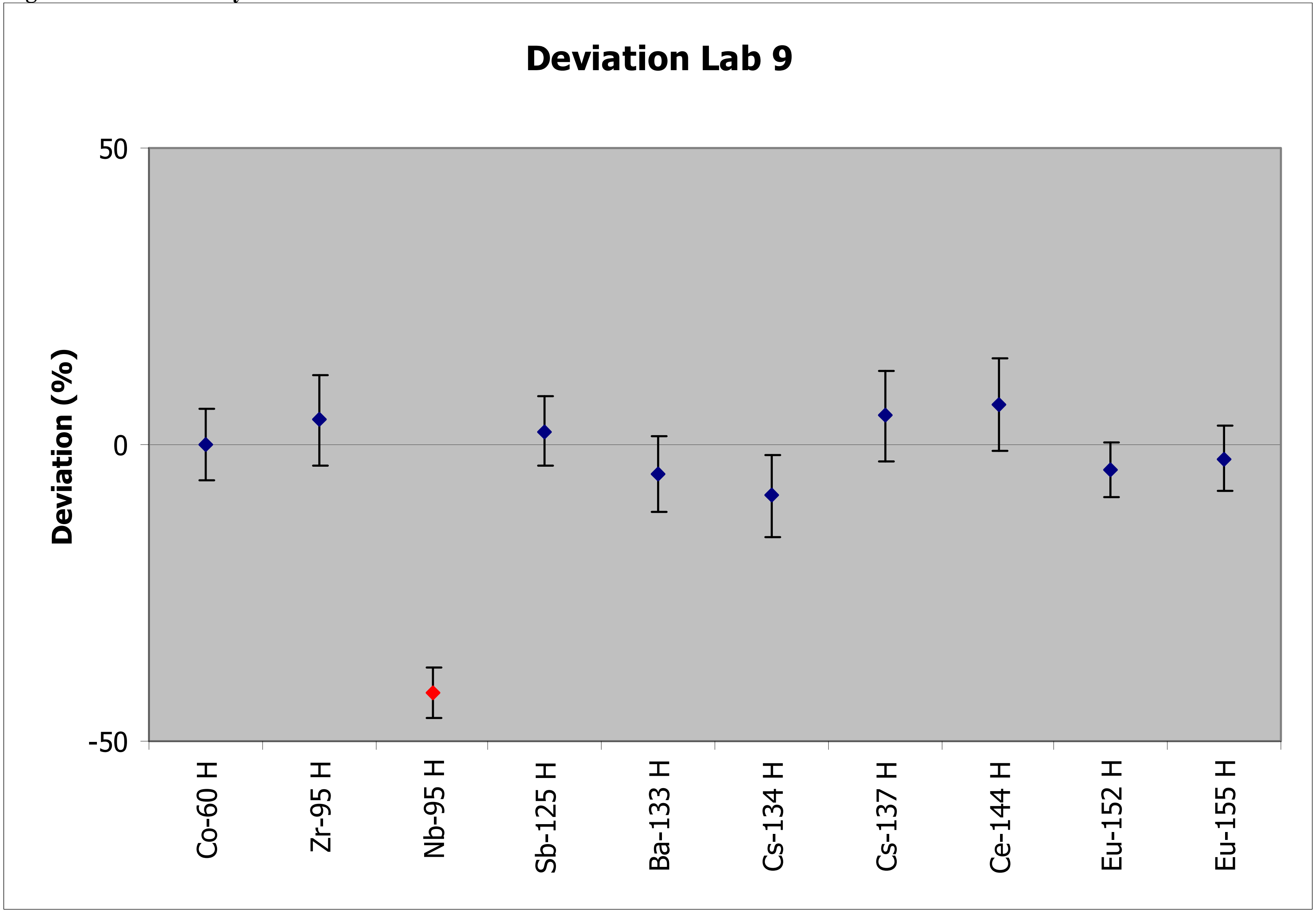


Figure 77 – Laboratory 13

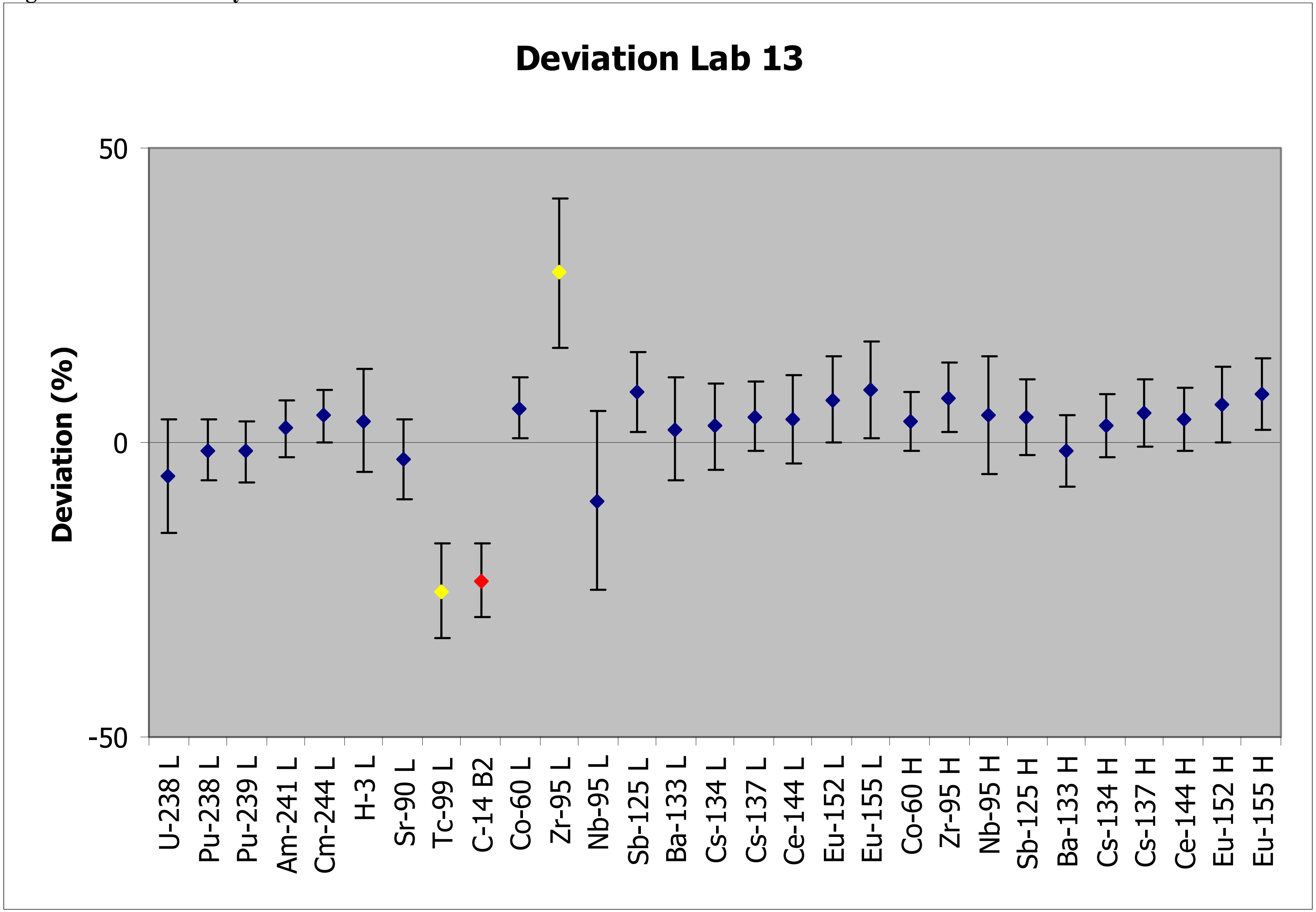


Figure 78 – Laboratory 14

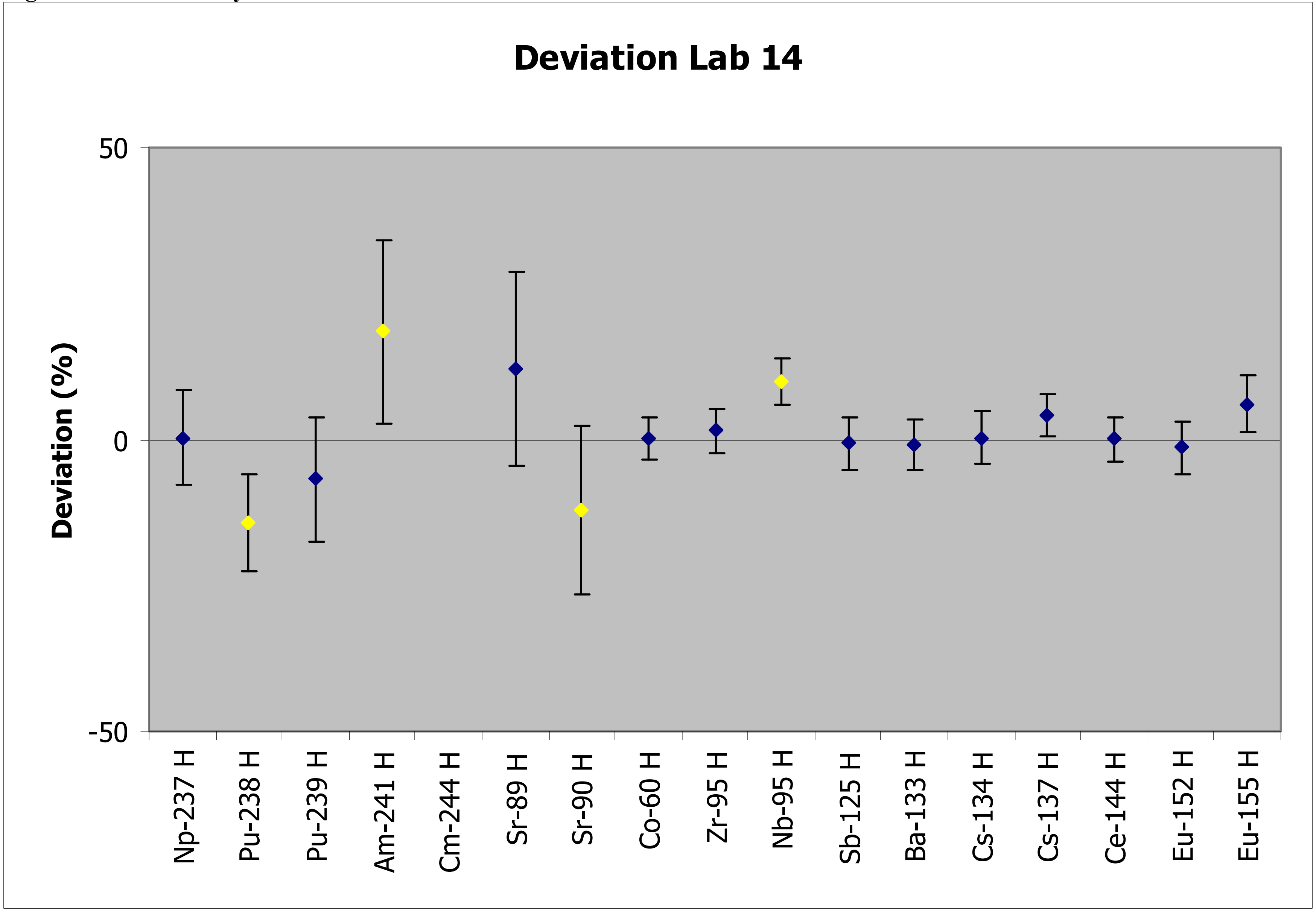


Figure 79 – Laboratory 15

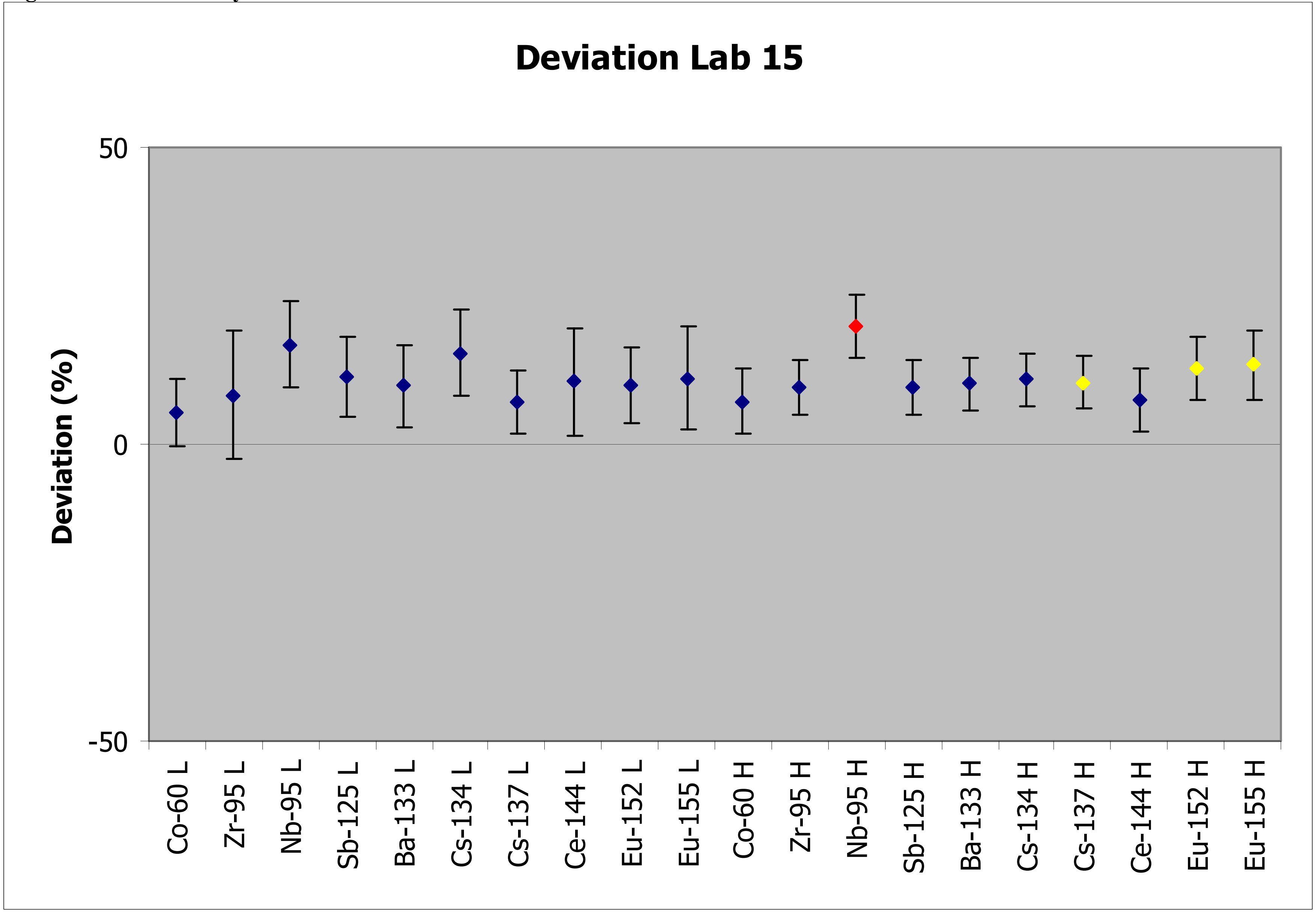


Figure 80 – Laboratory 16

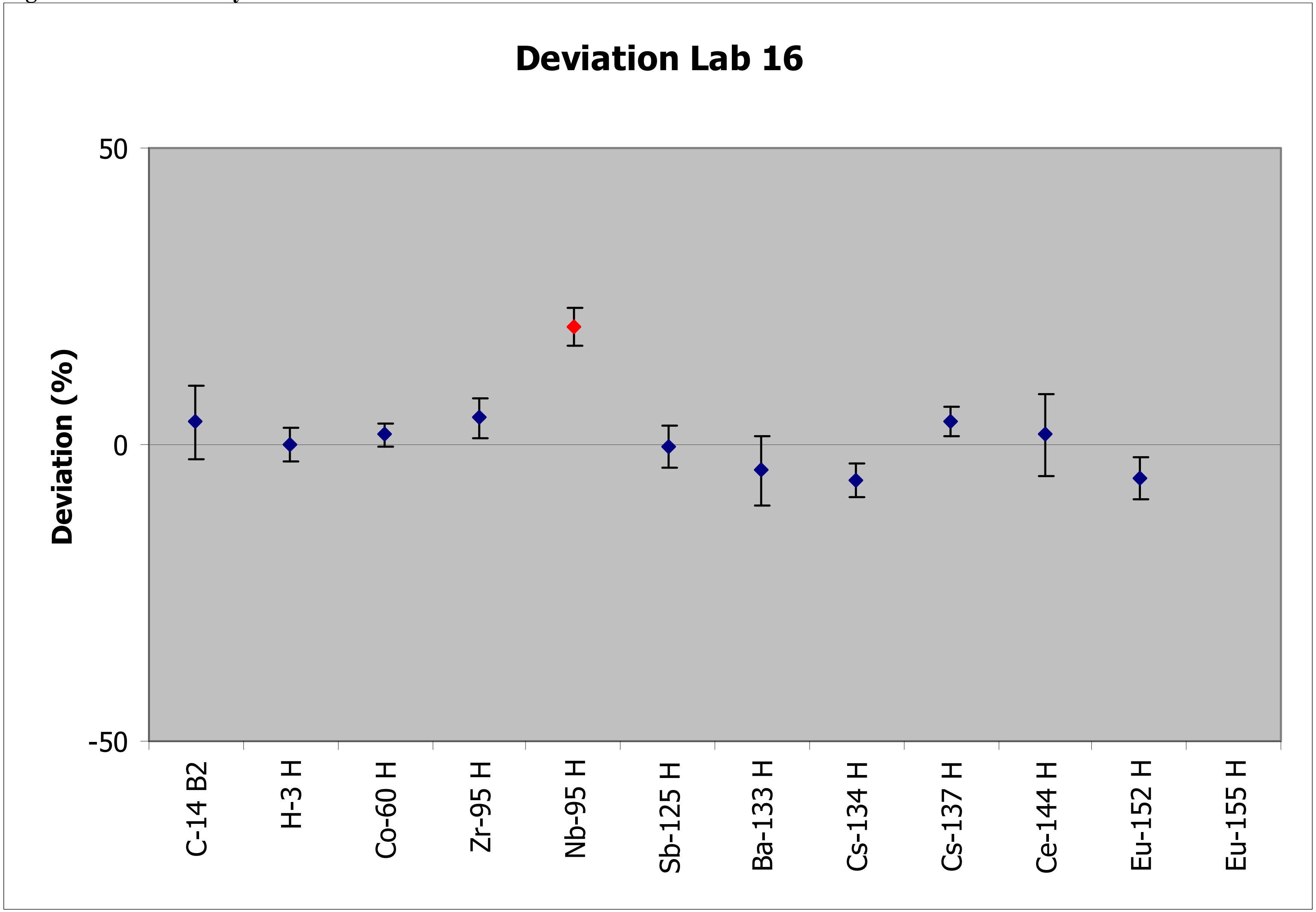


Figure 81 – Laboratory 17

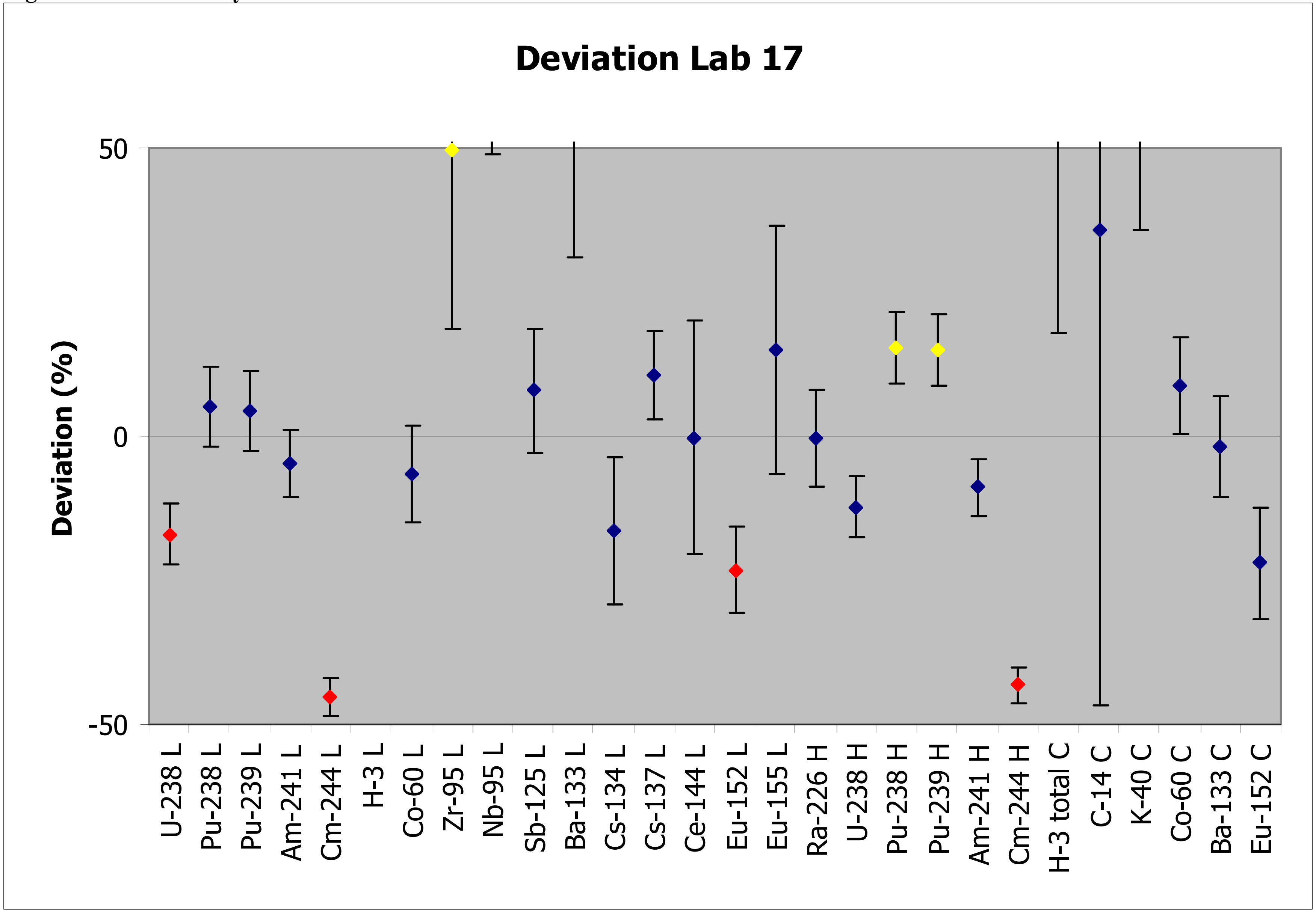


Figure 82 – Laboratory 18

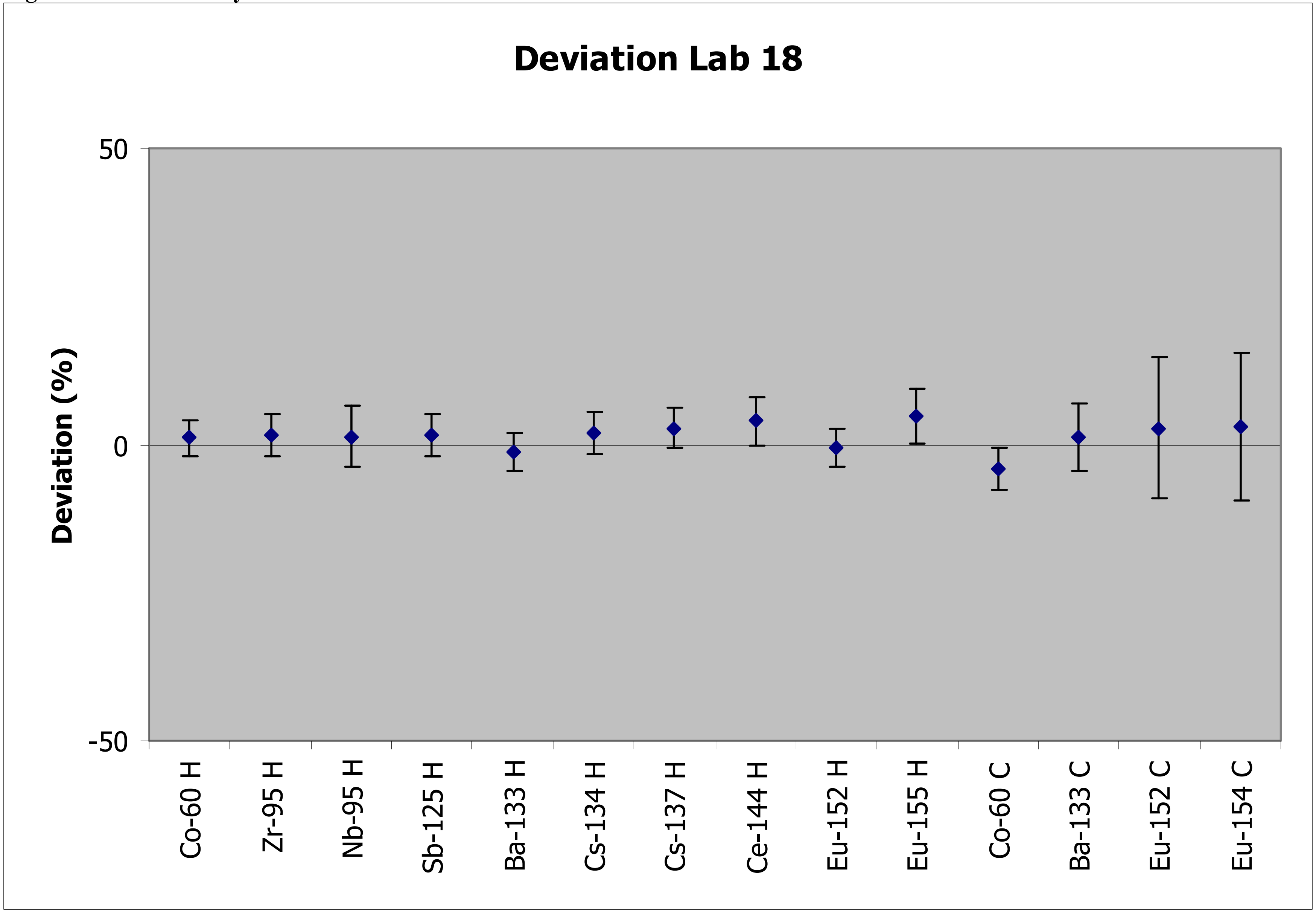


Figure 83 – Laboratory 19

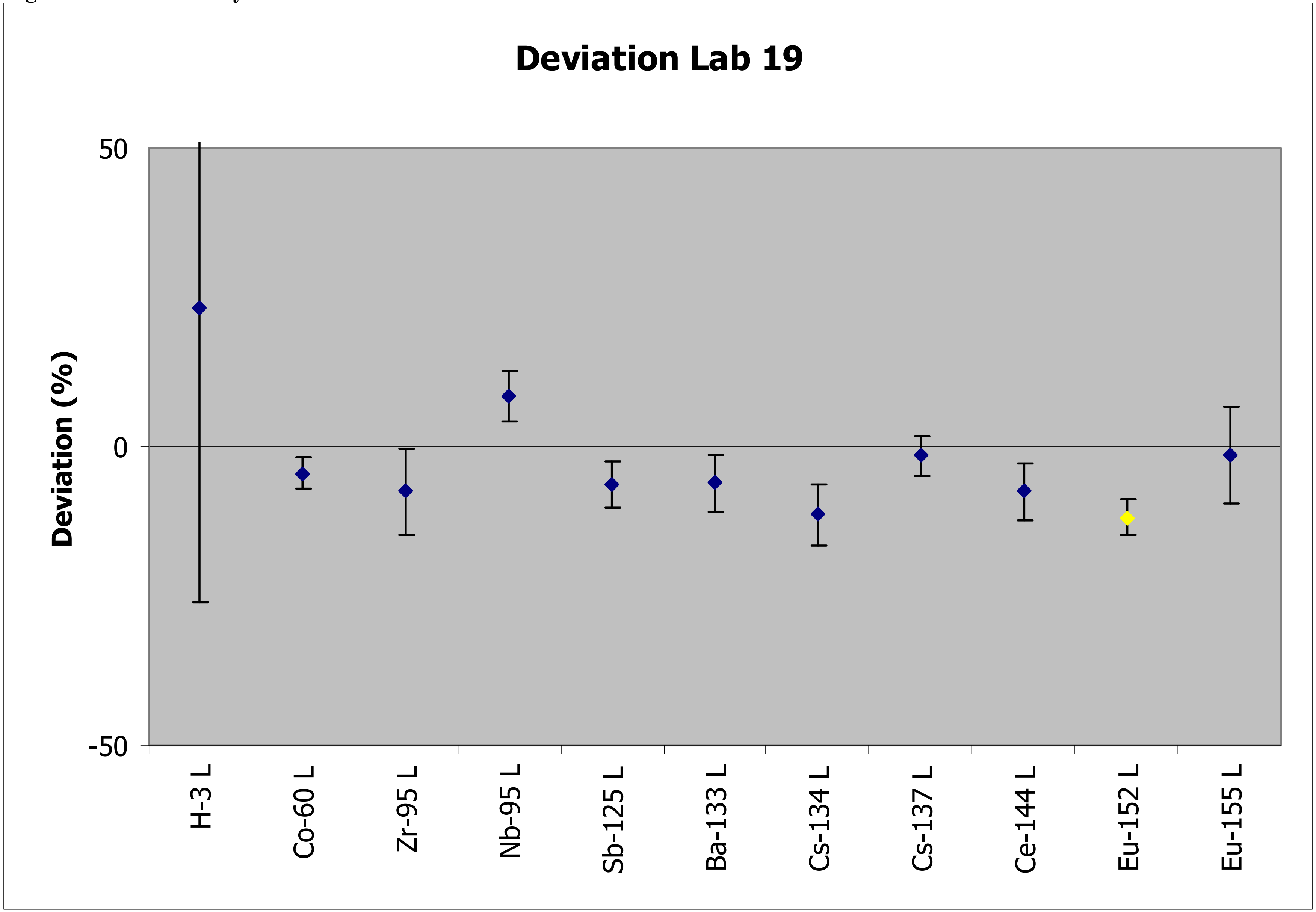


Figure 84 – Laboratory 21

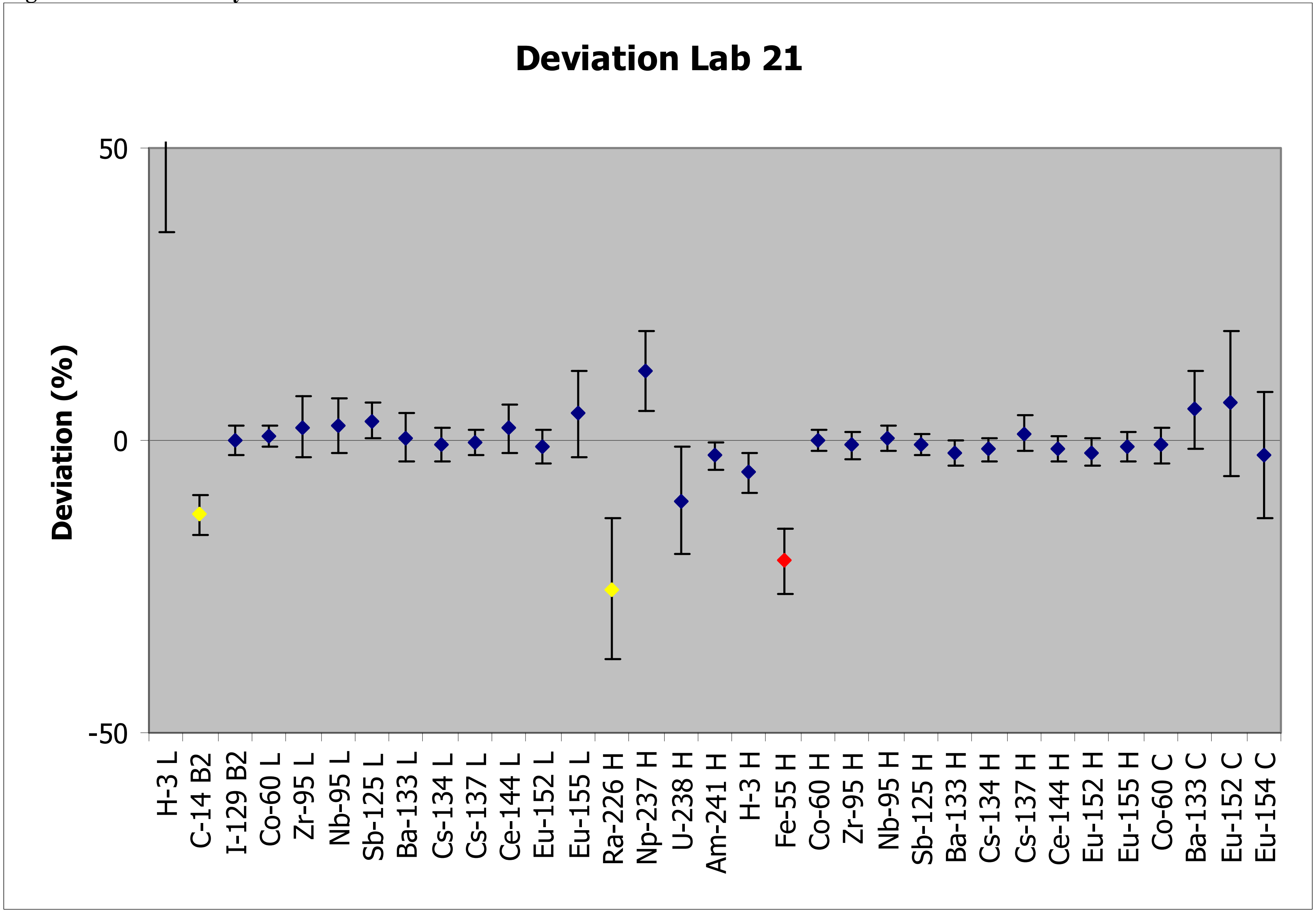


Figure 85 – Laboratory 22

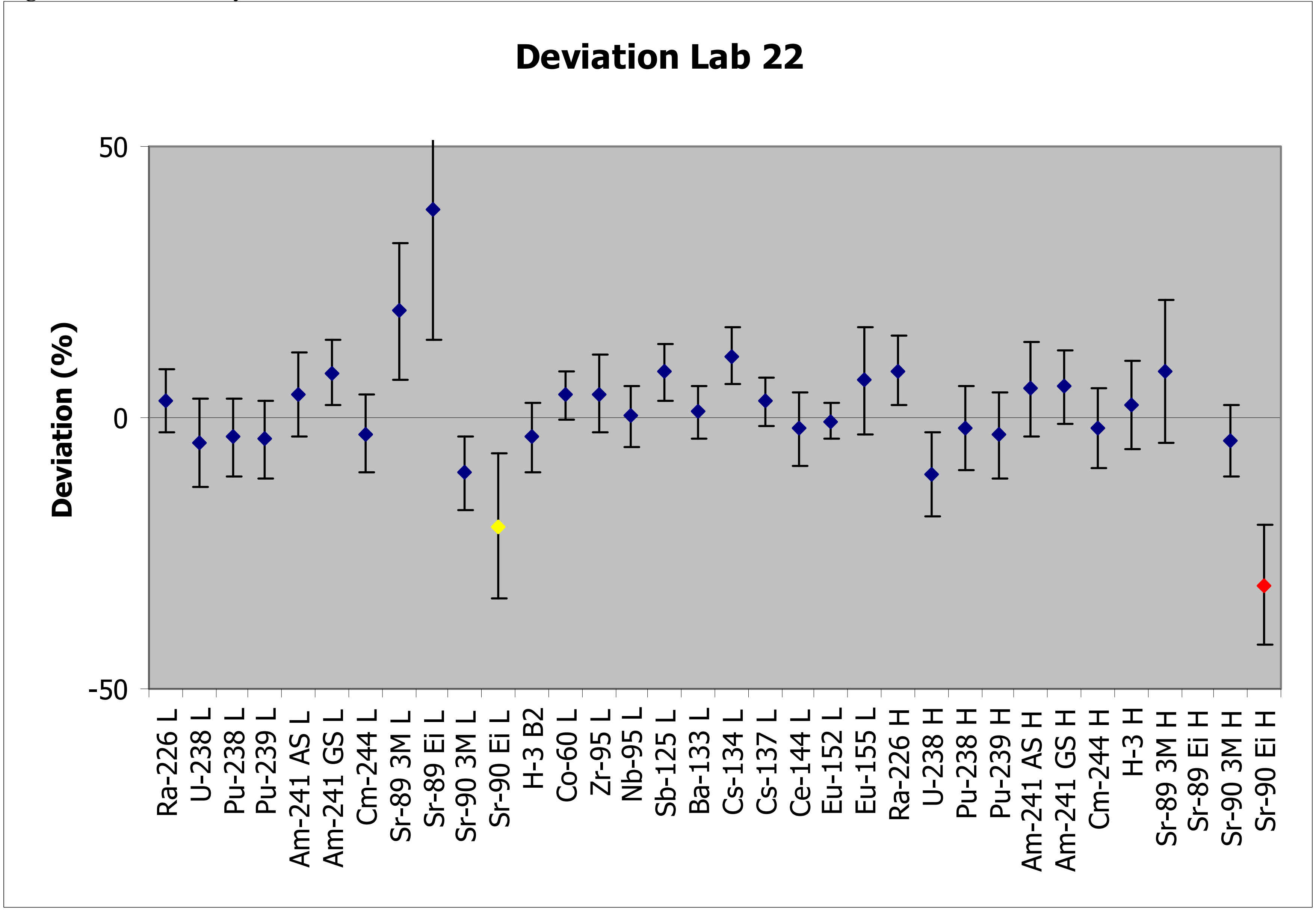


Figure 86 – Laboratory 23

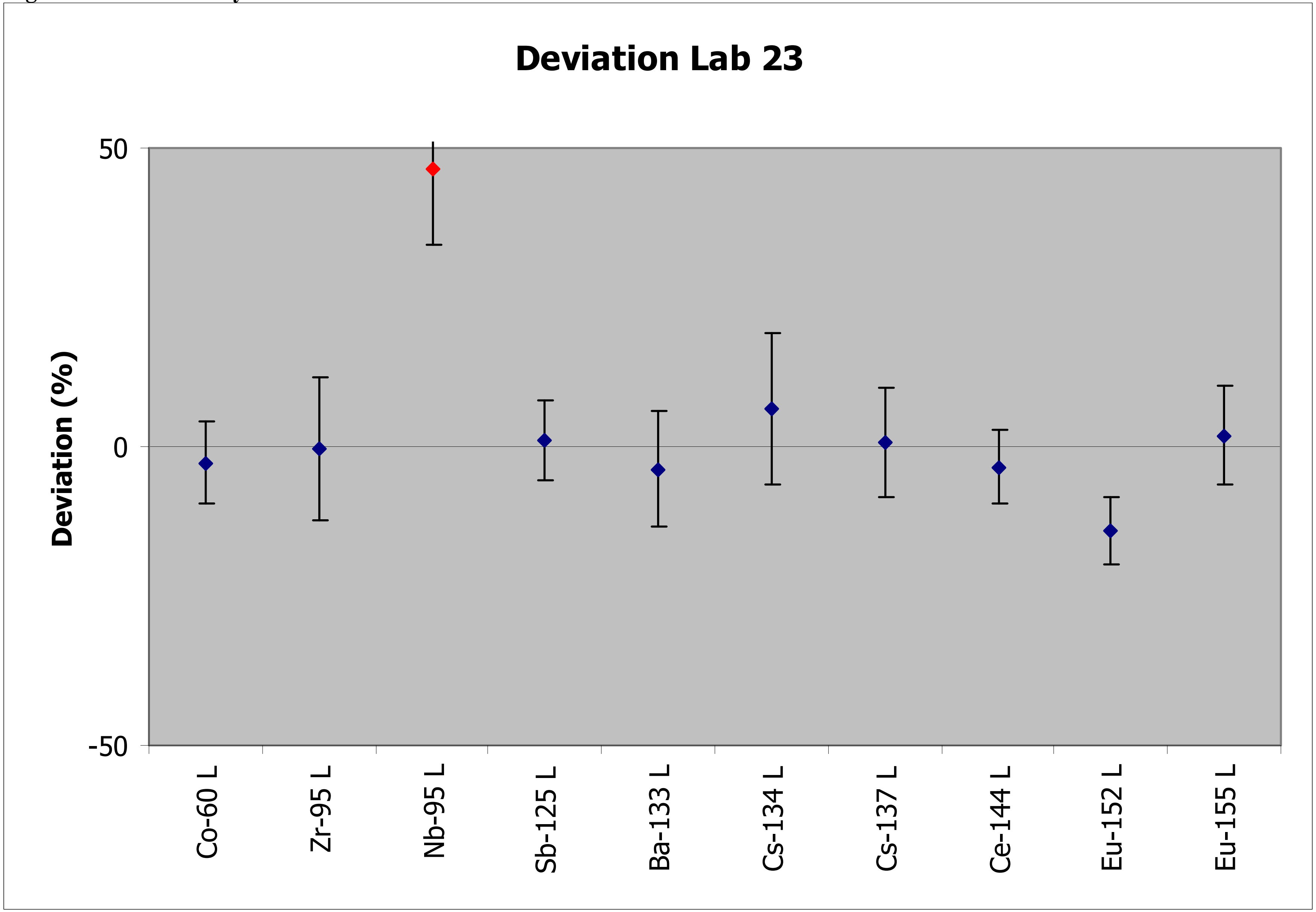


Figure 87 – Laboratory 25

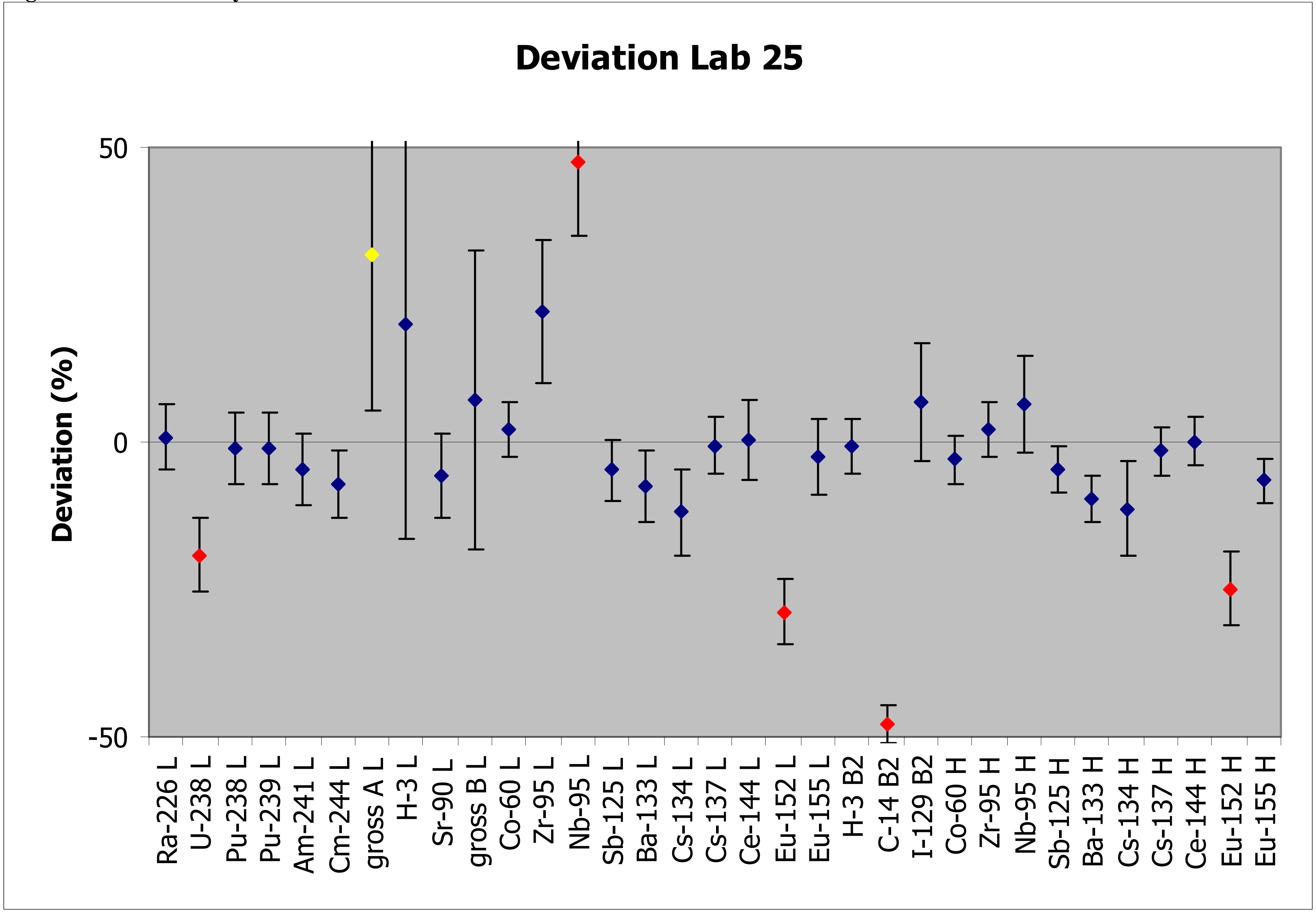


Figure 88 – Laboratory 26

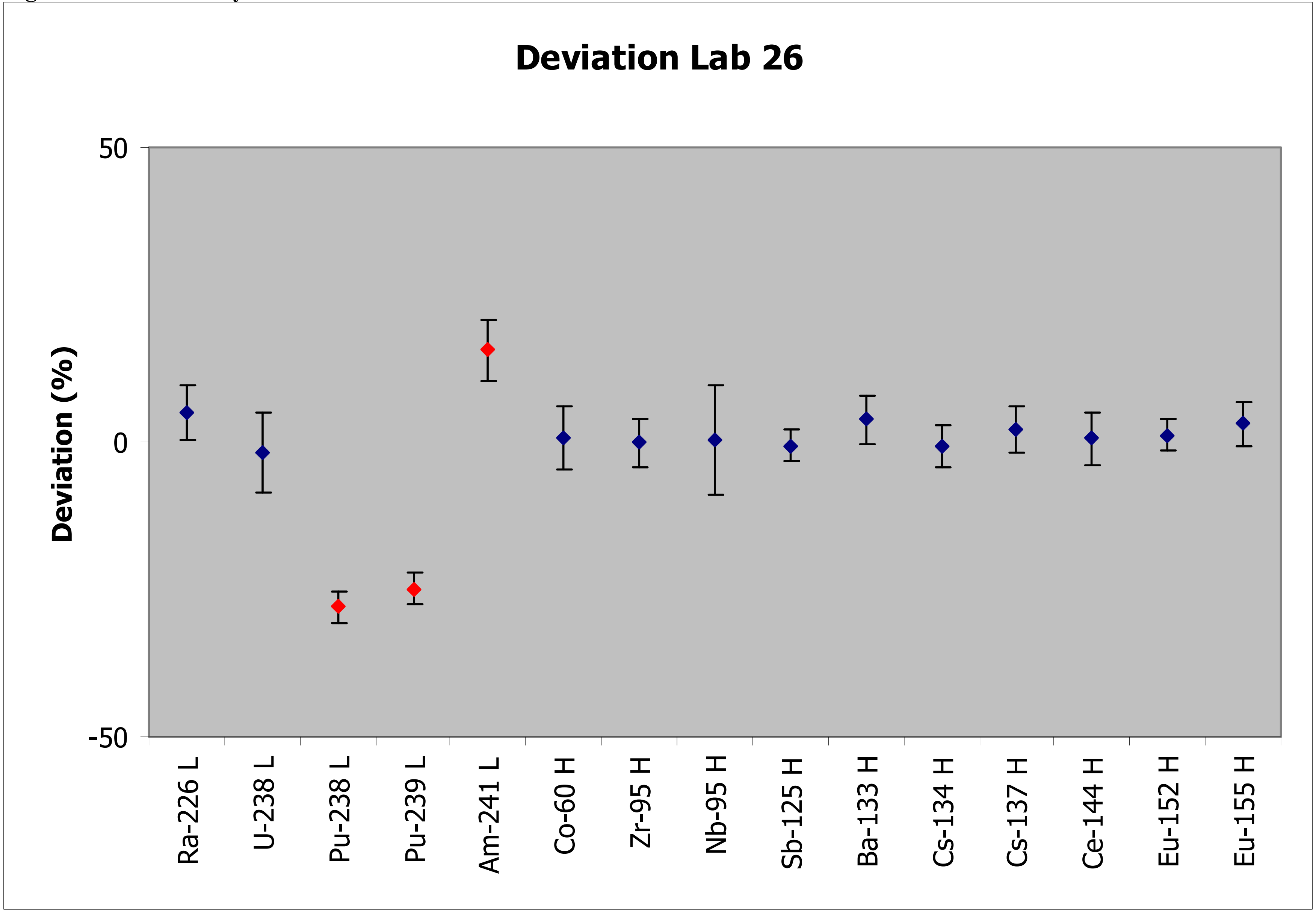


Figure 89 – Laboratory 27

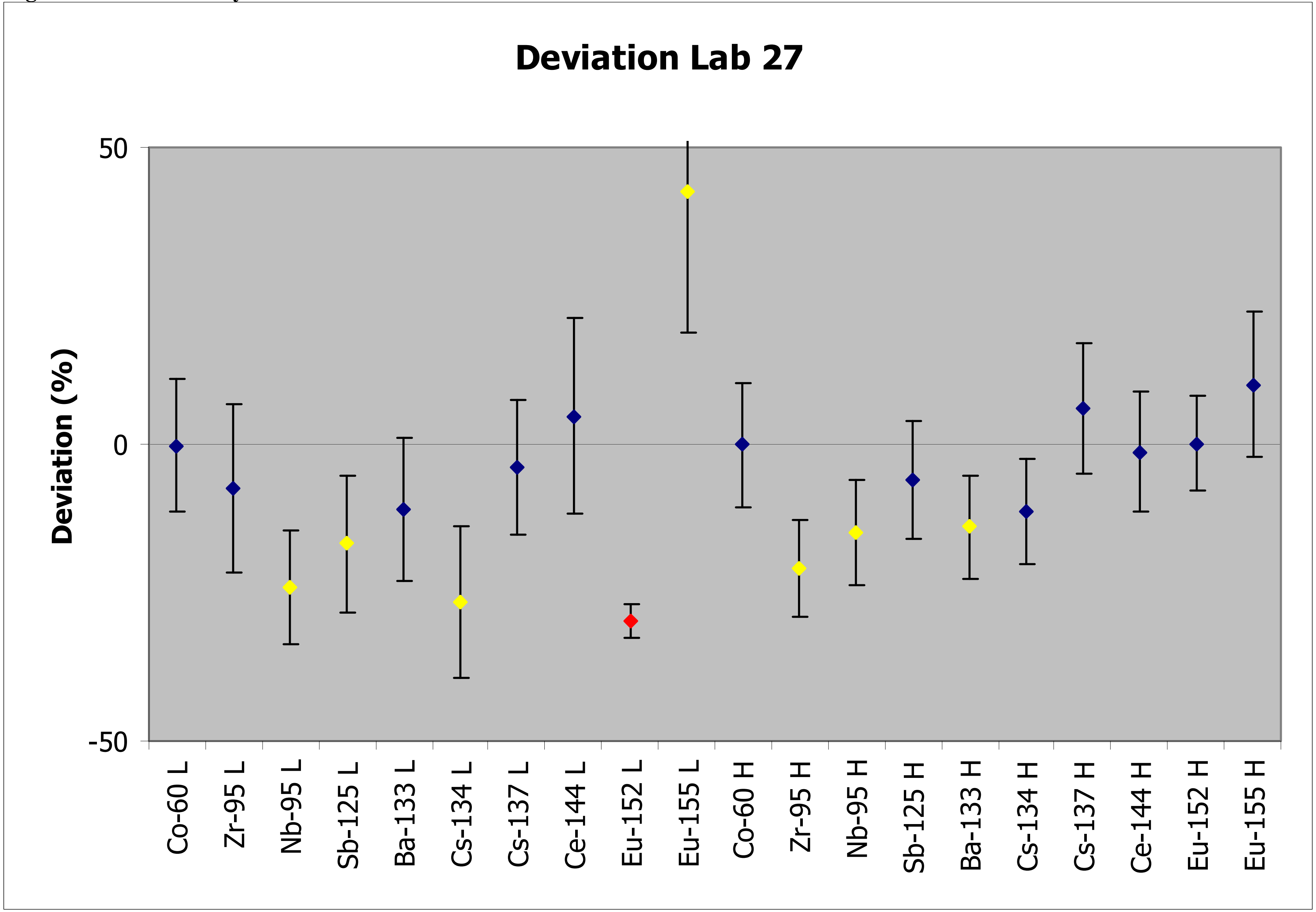


Figure 90 – Laboratory 28

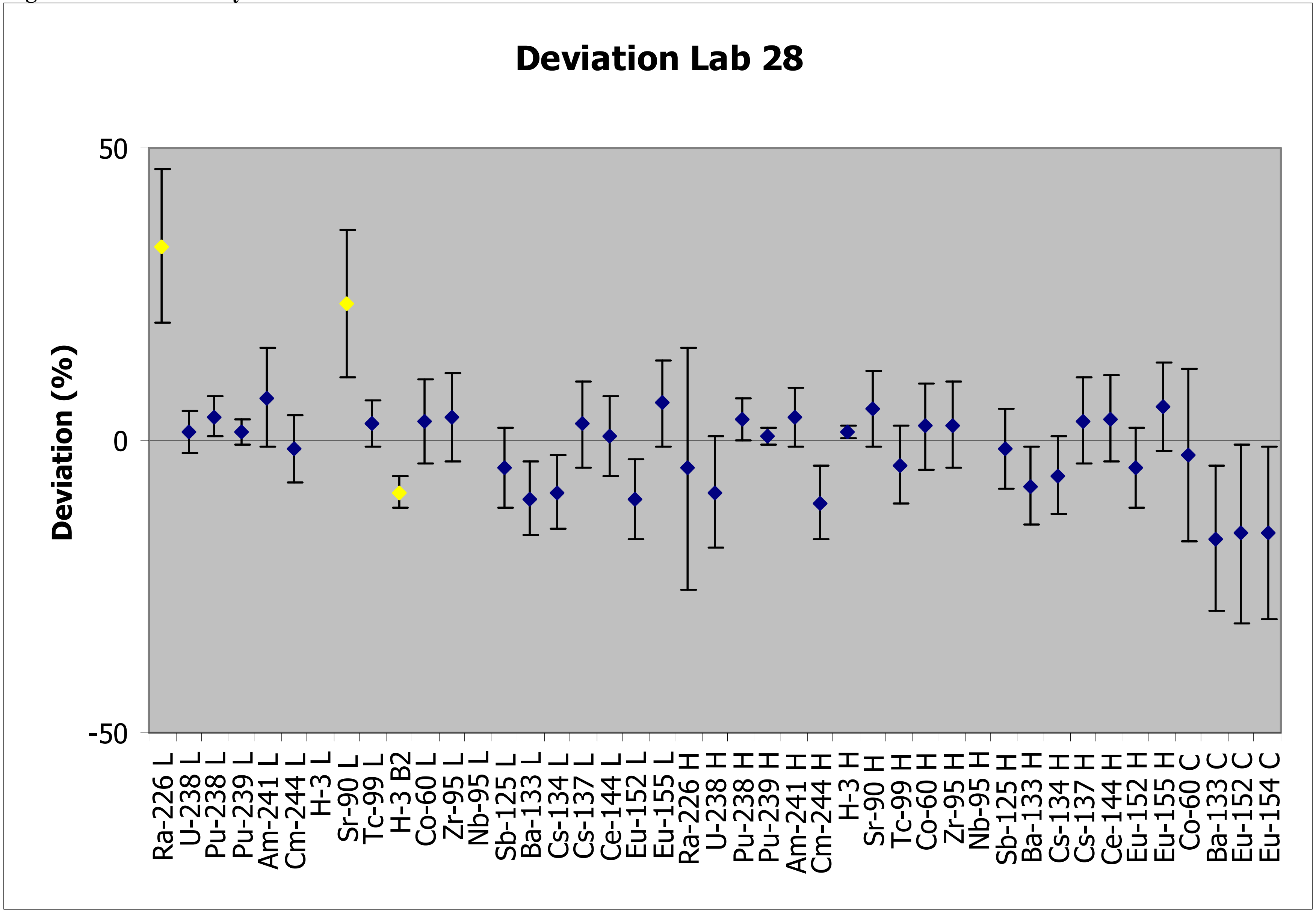


Figure 91 – Laboratory 29

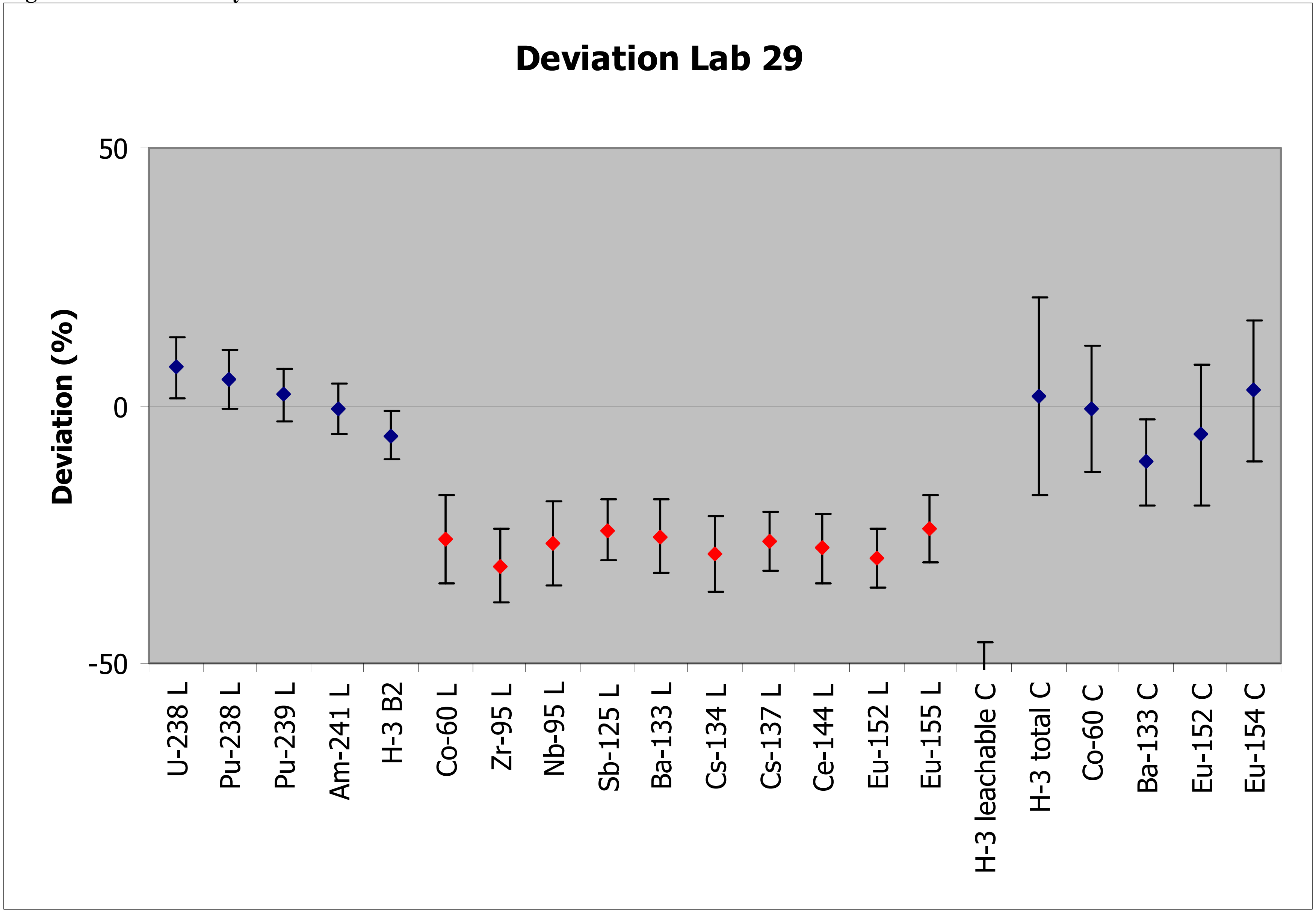


Figure 92 – Laboratory 30

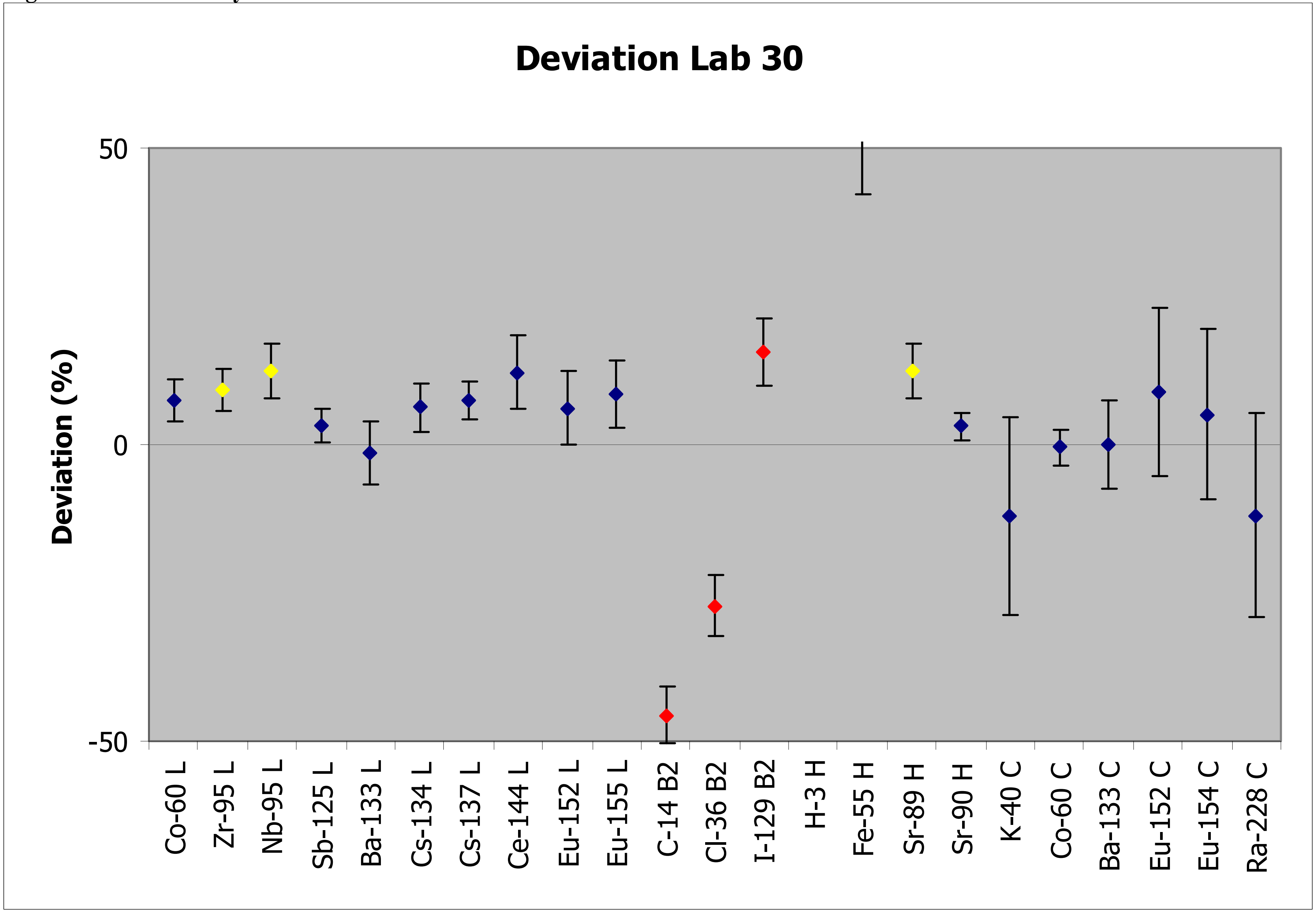


Figure 93 – Laboratory 32

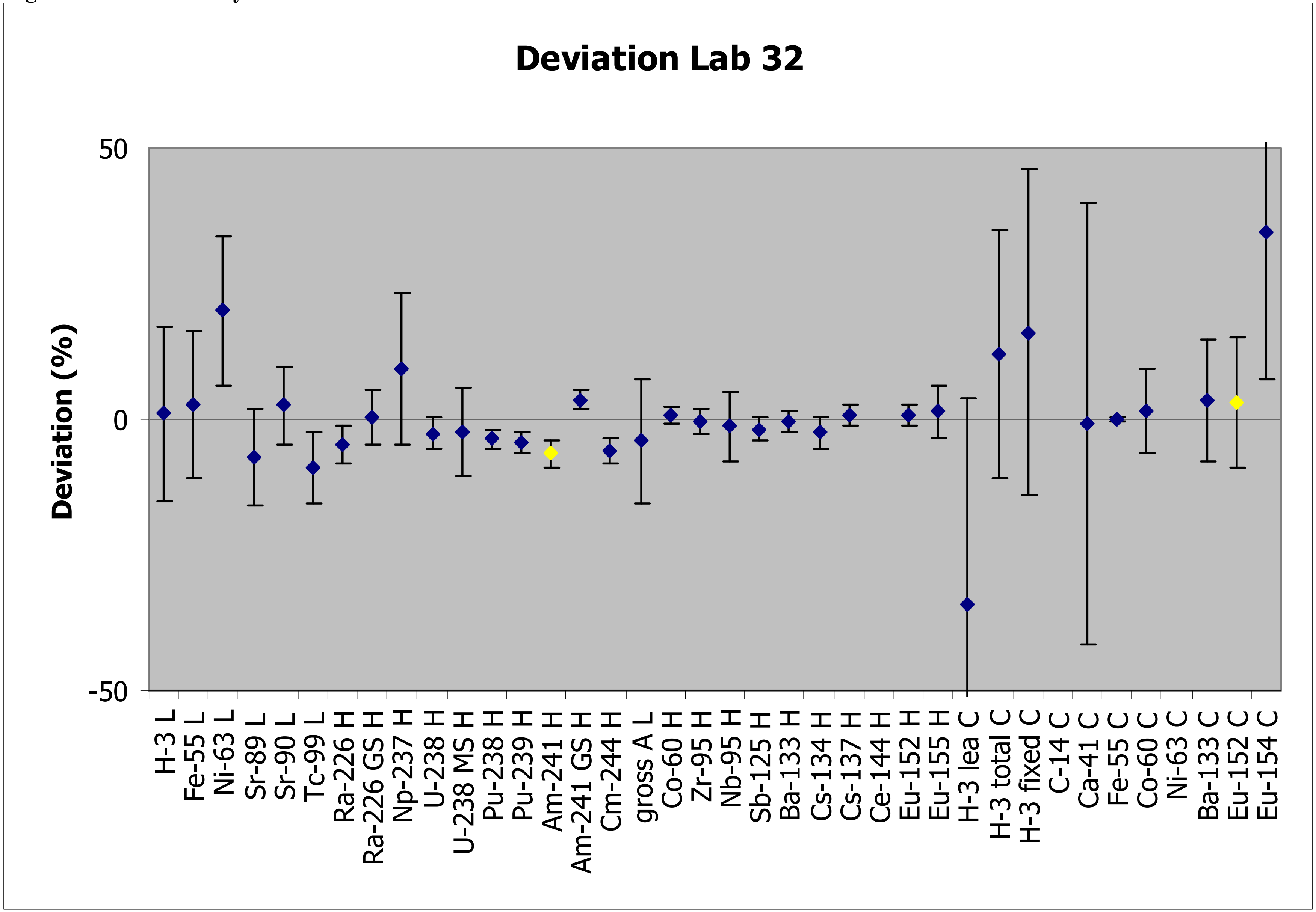


Figure 94 – Laboratory 34

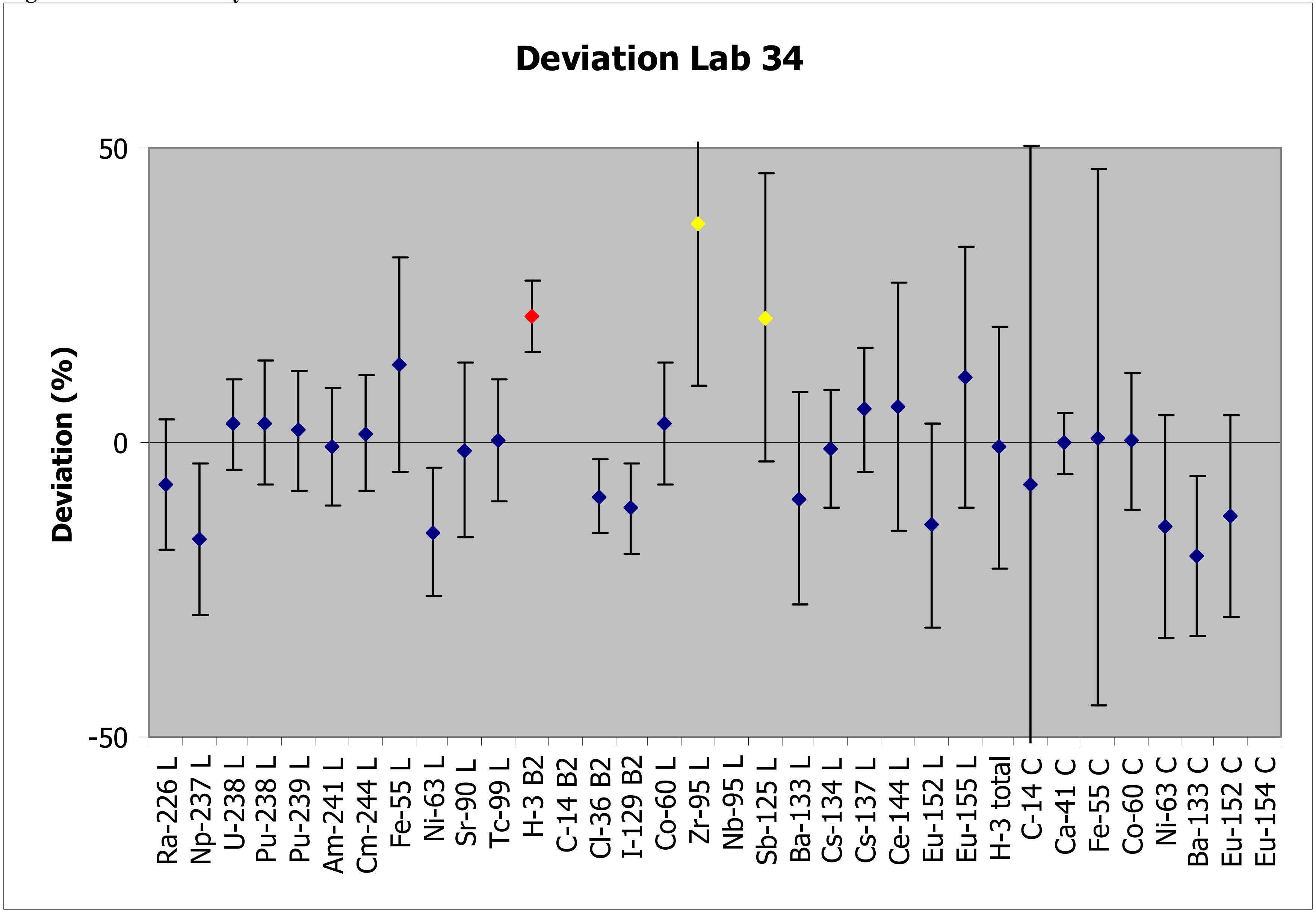


Figure 95 – Laboratory 35

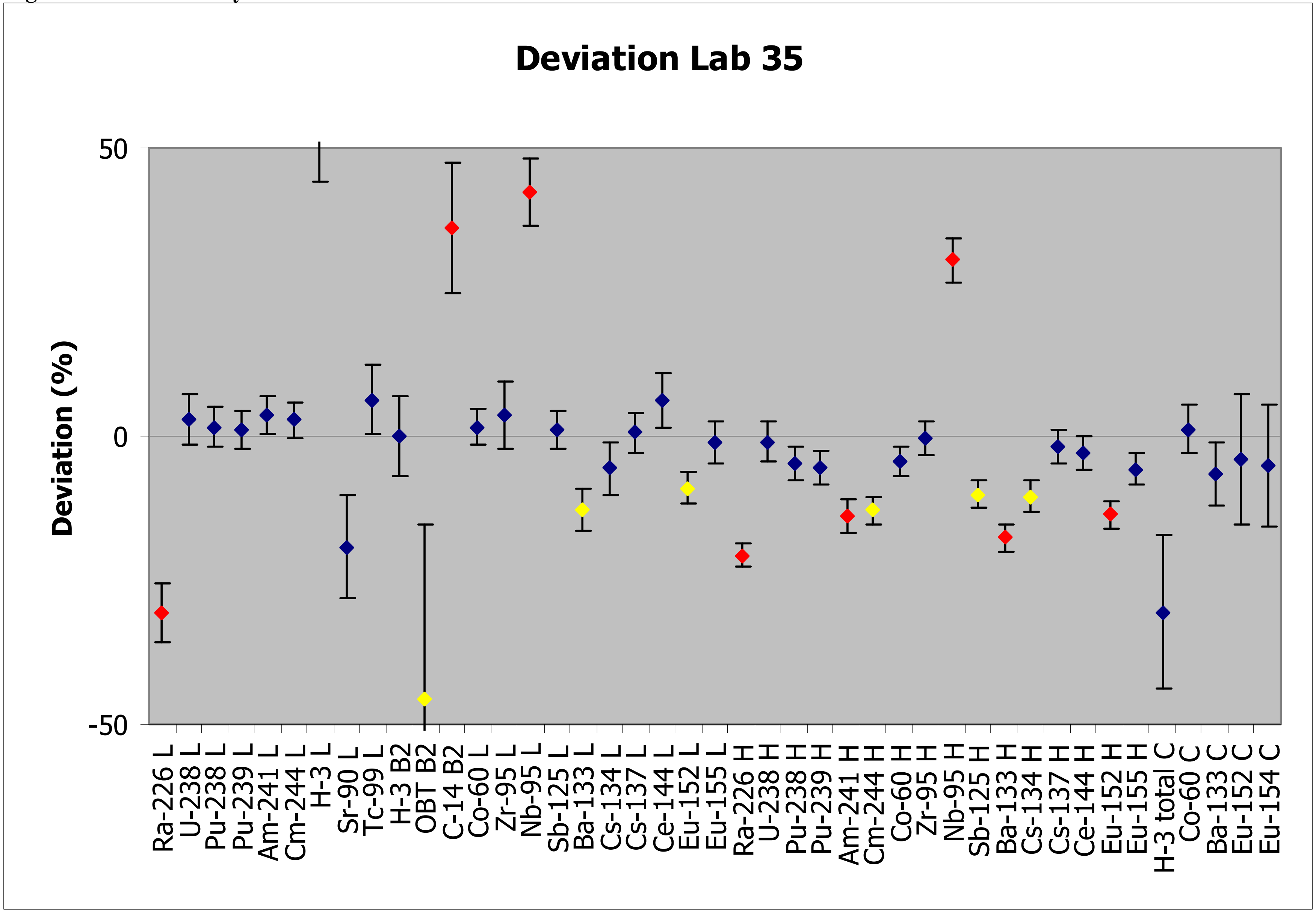


Figure 96 – Laboratory 38

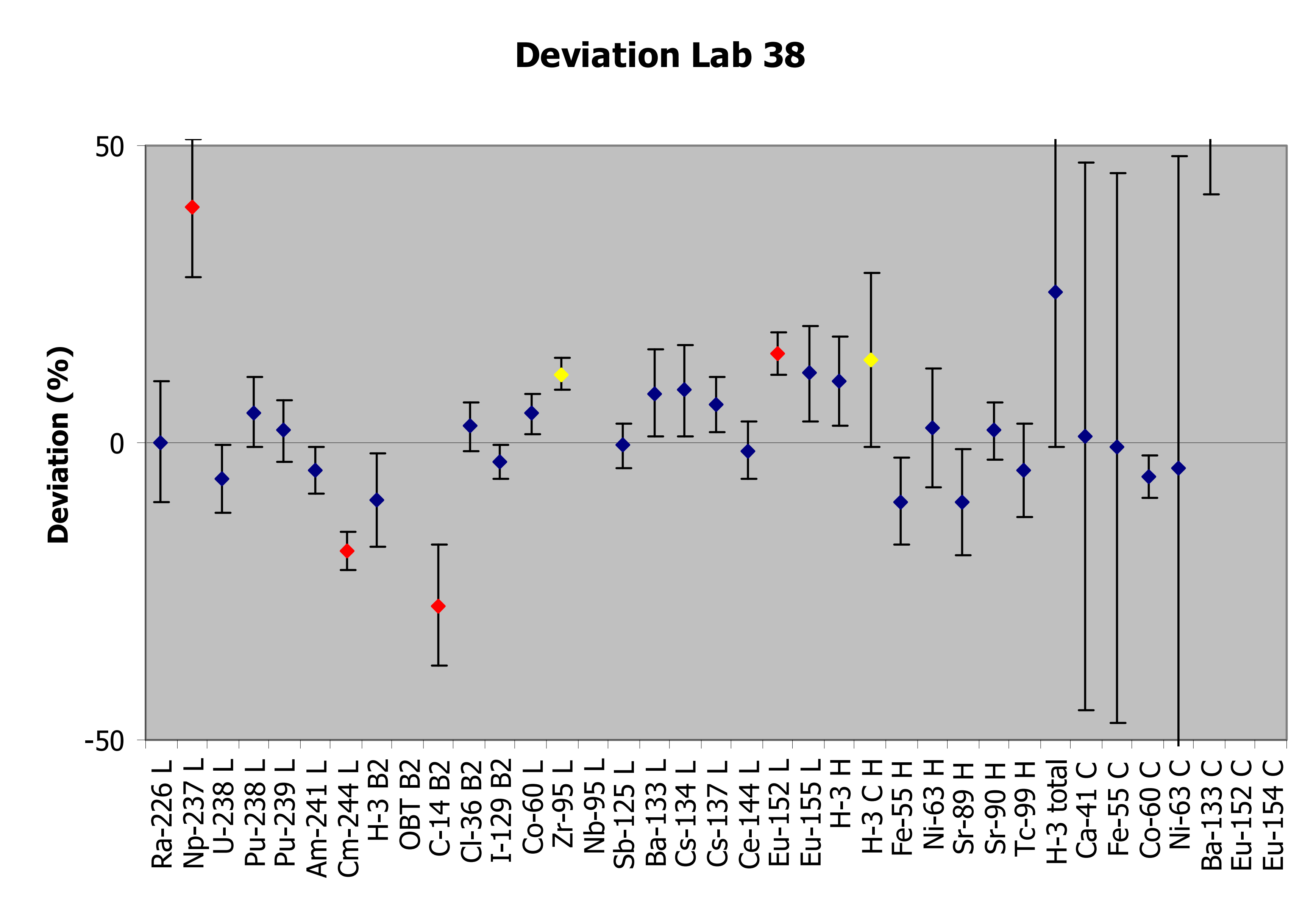


Figure 97 – Laboratory 39

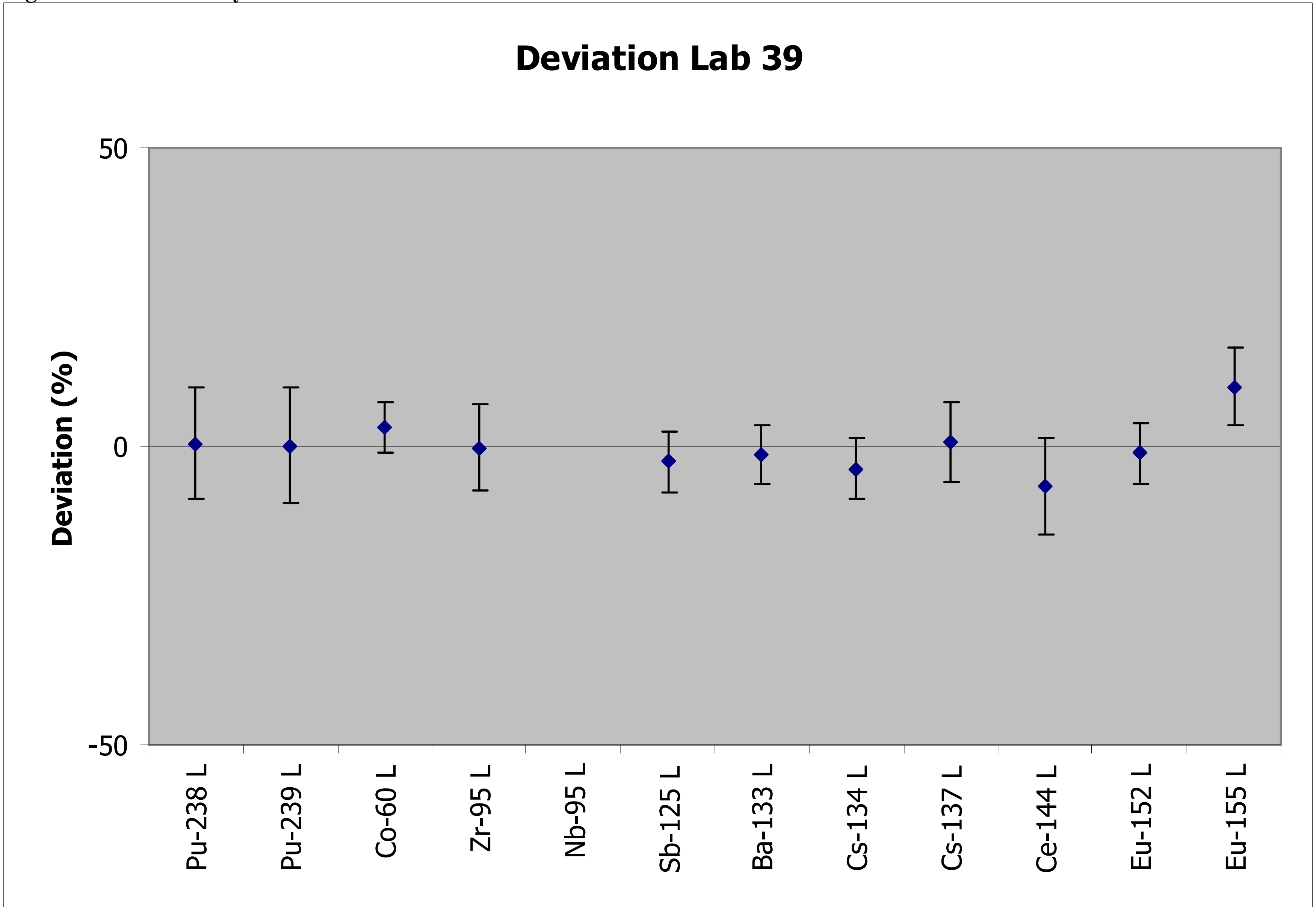


Figure 98 – Laboratory 40

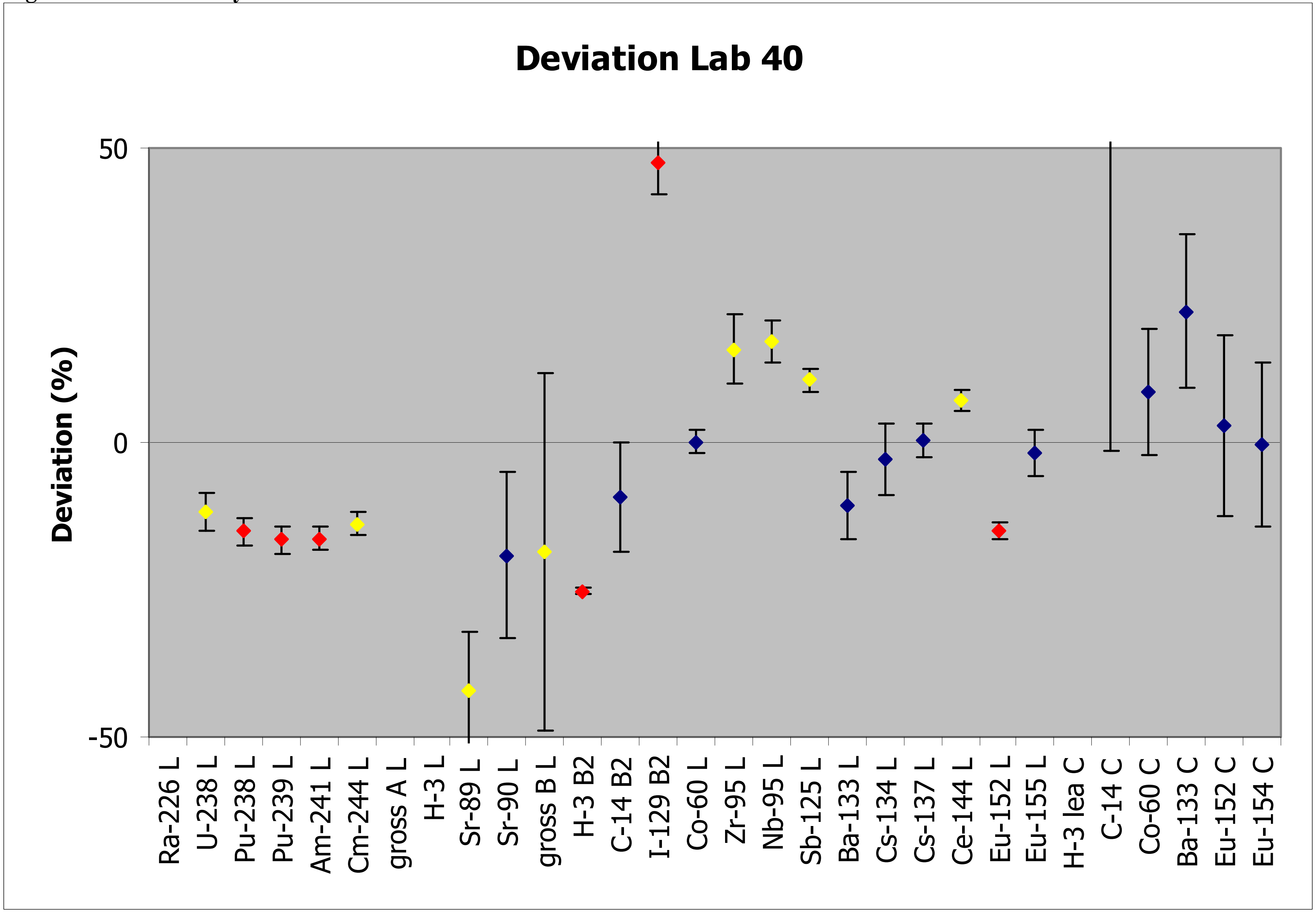


Figure 99 – Laboratory 41

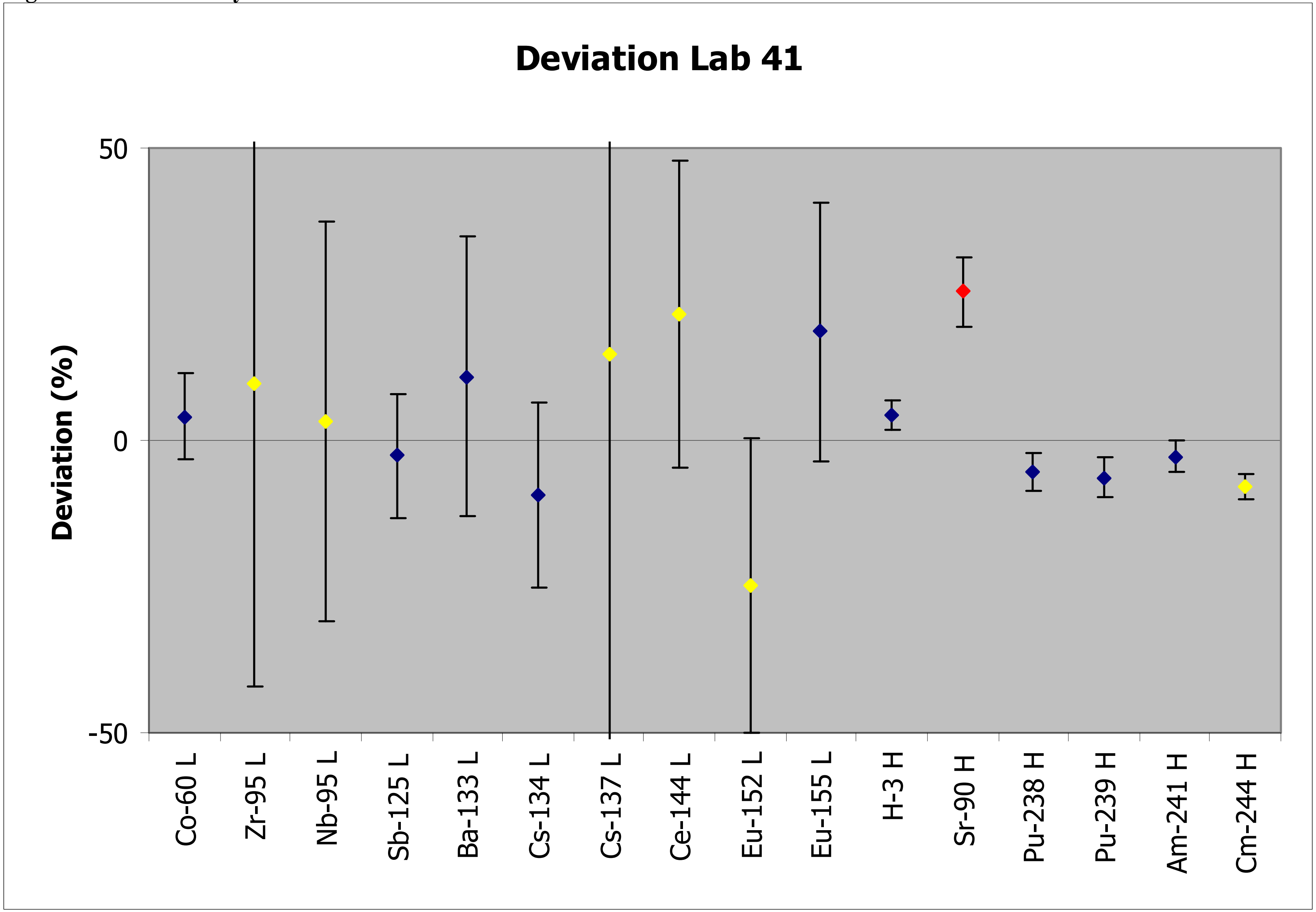


Figure 100 – Laboratory 42

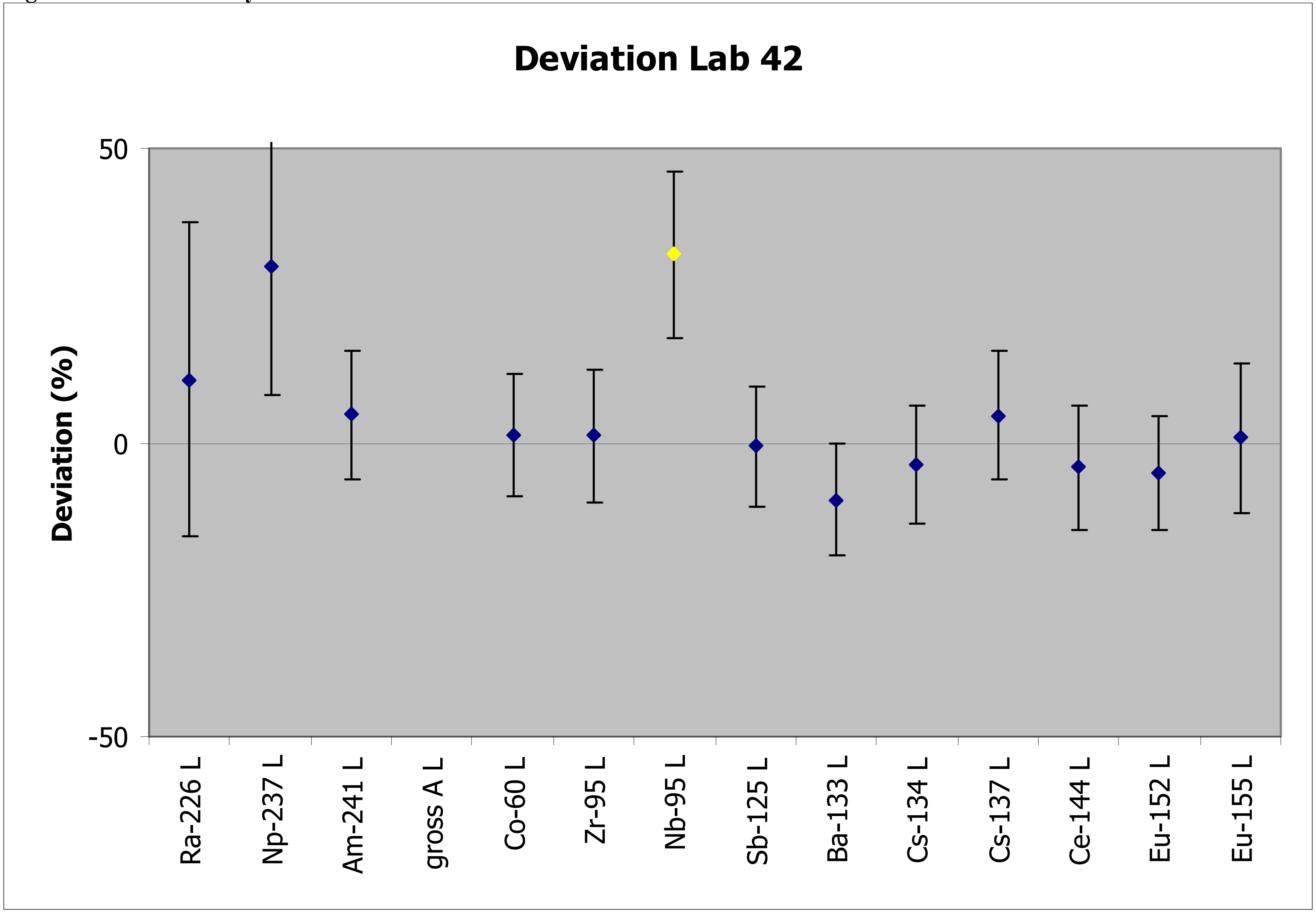


Figure 101 – Laboratory 45

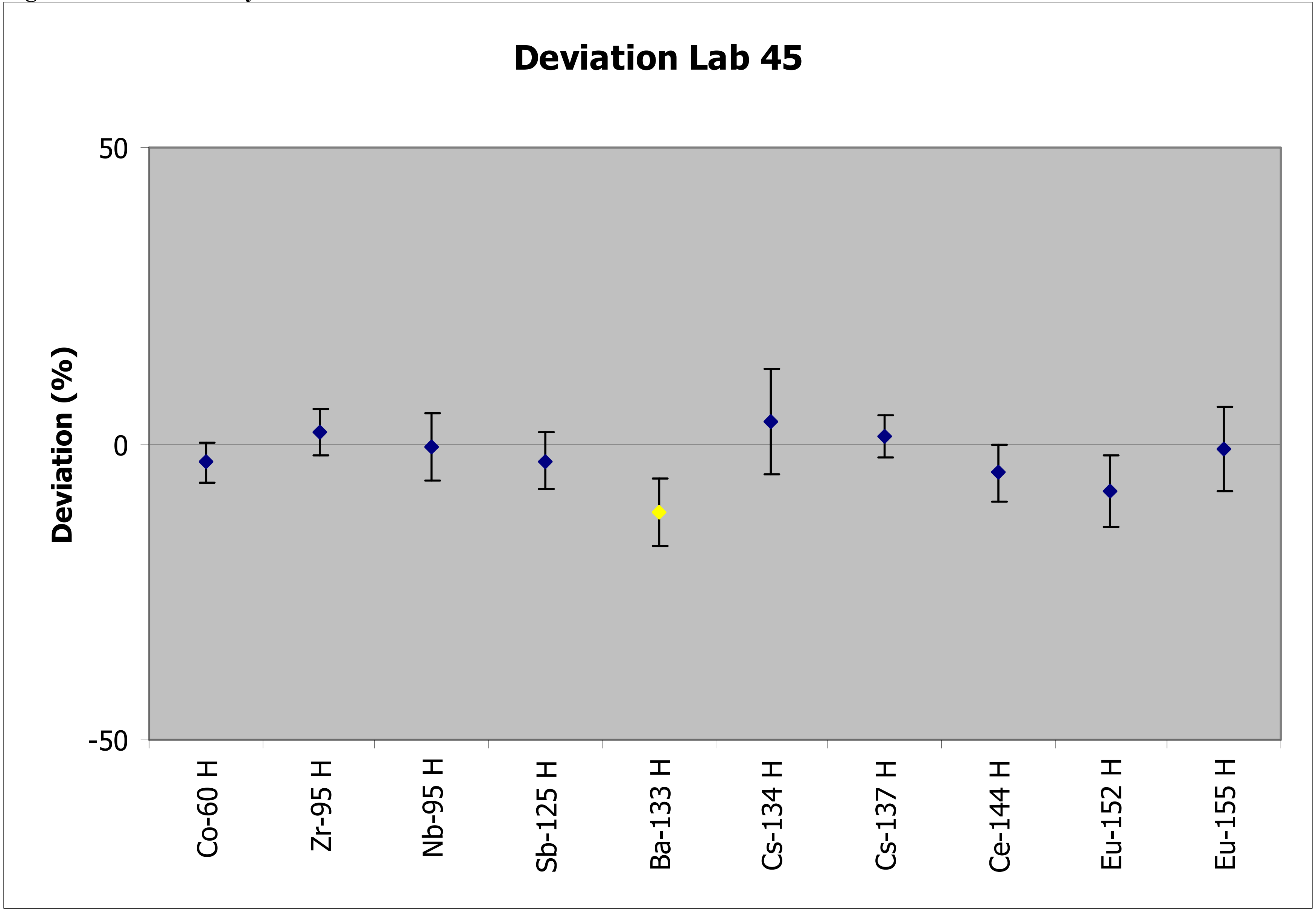


Figure 102 – Laboratory 46

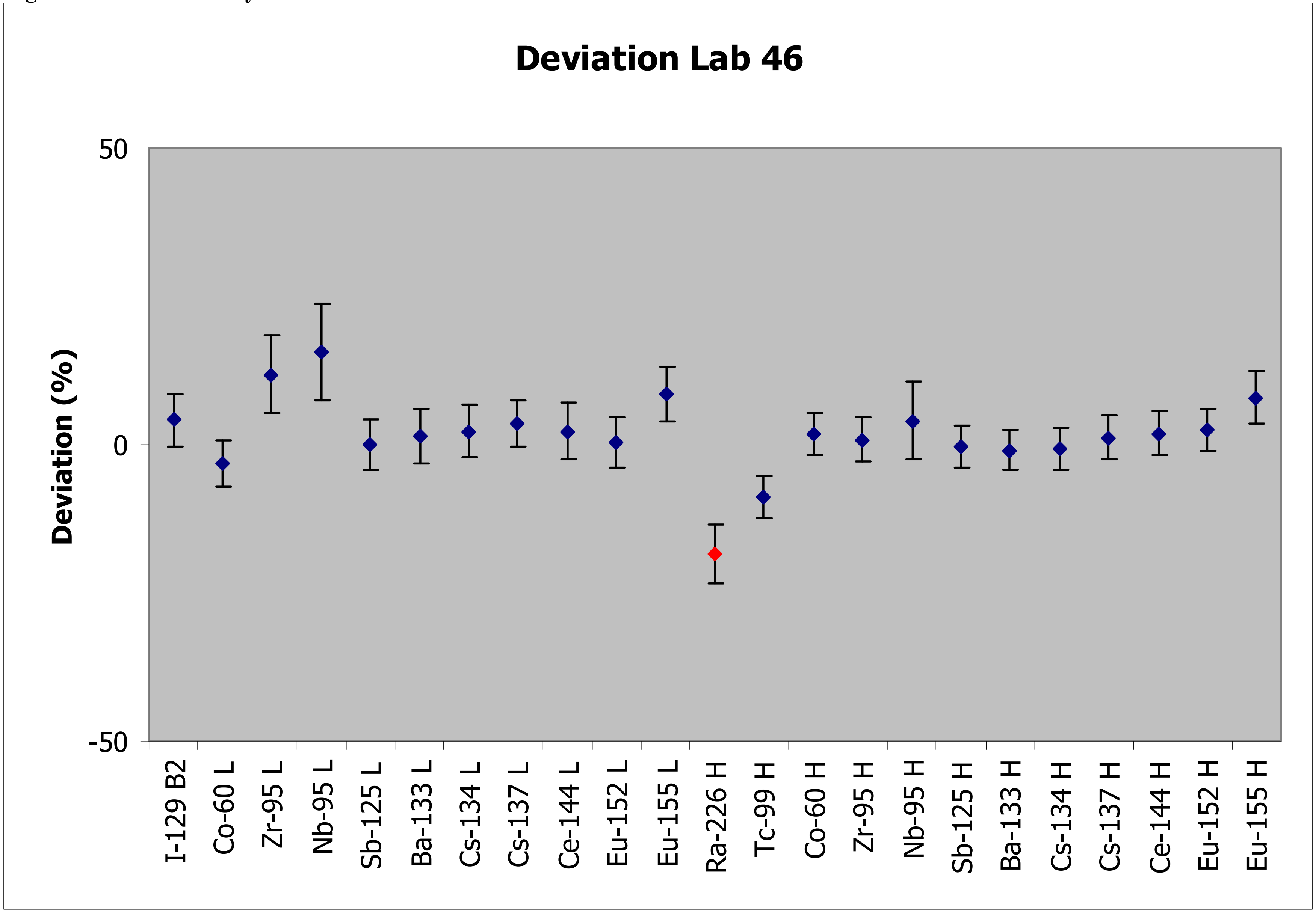


Figure 103 – Laboratory 47

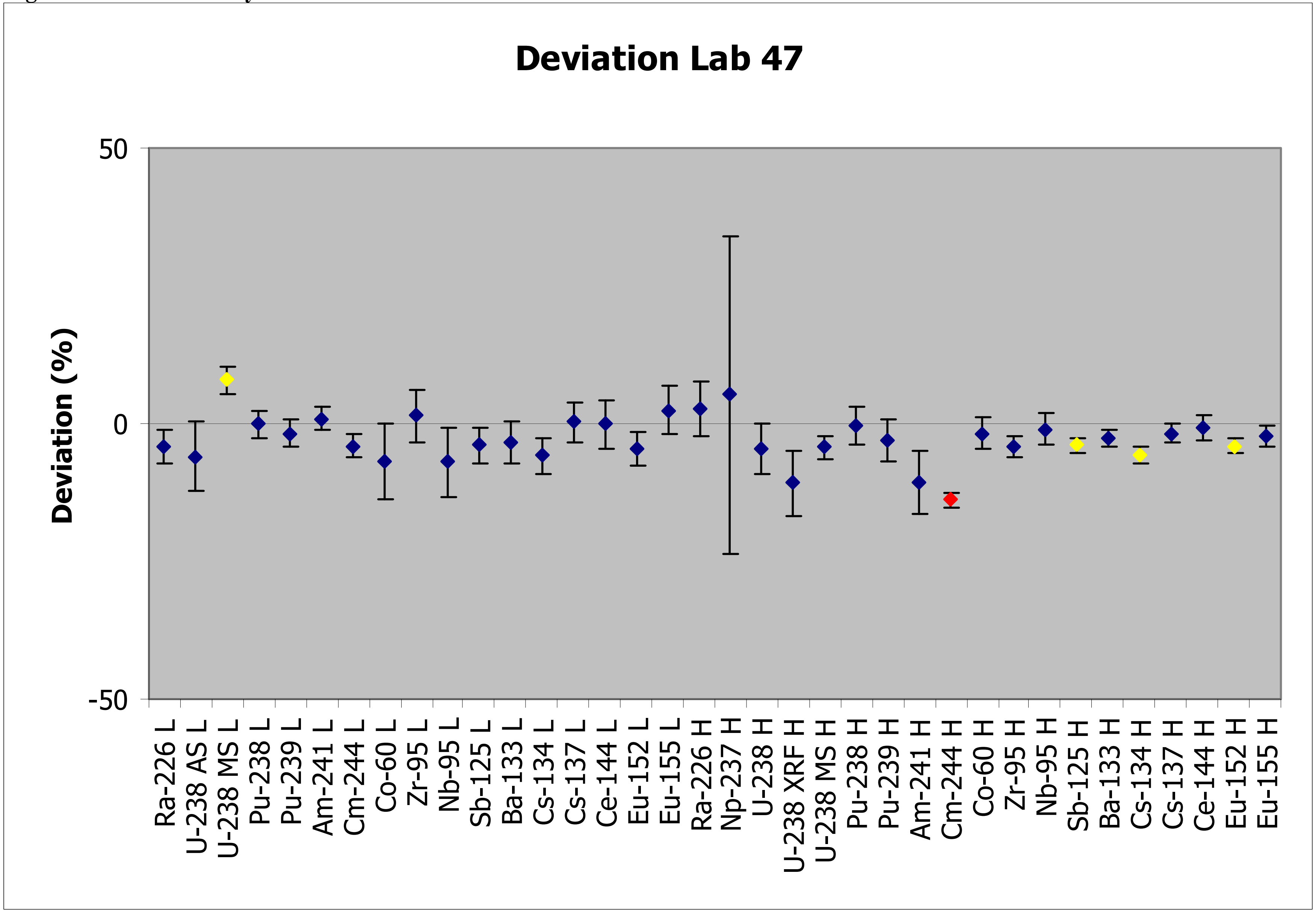


Figure 104 – Laboratory 48

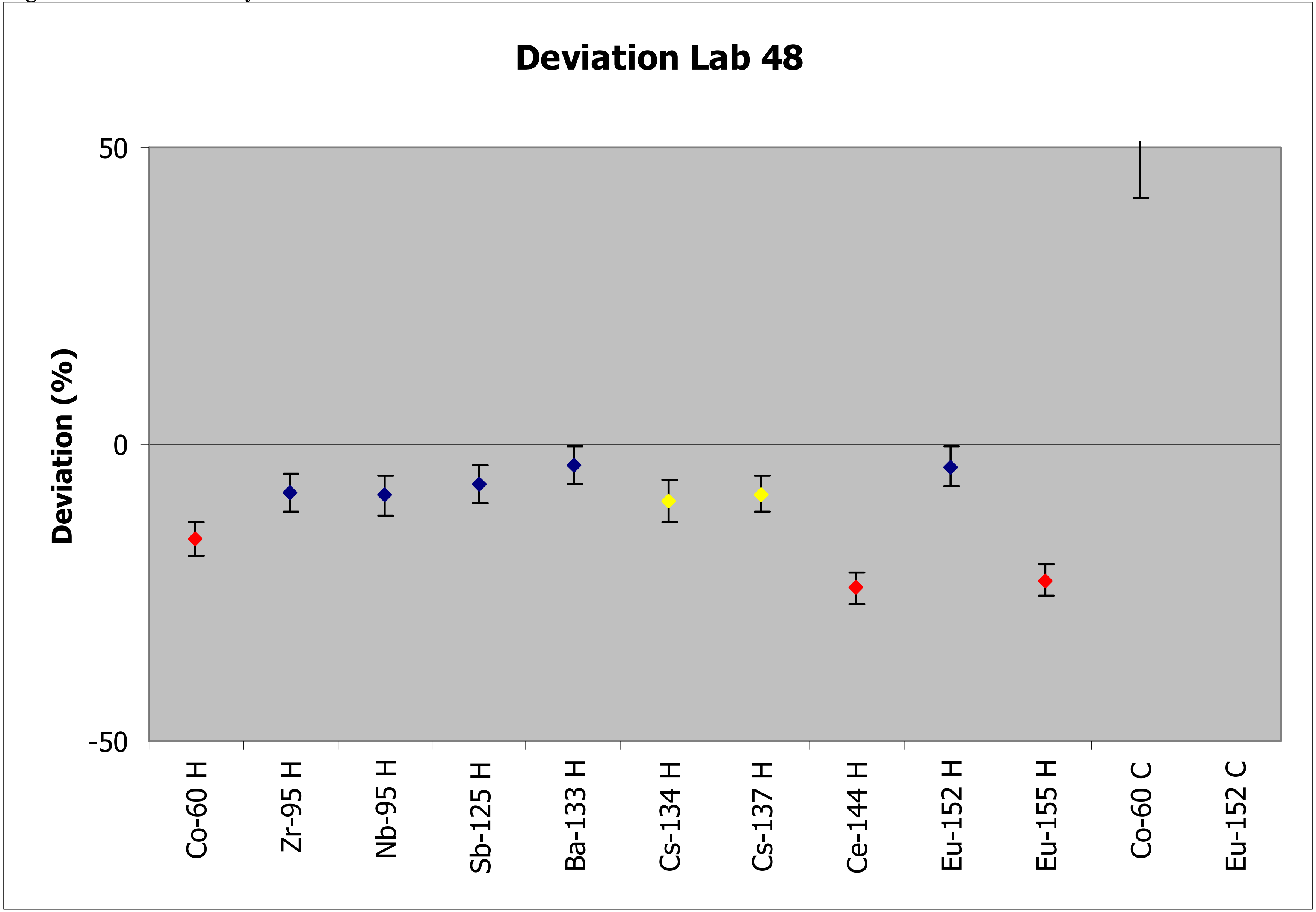


Figure 105 – Laboratory 52

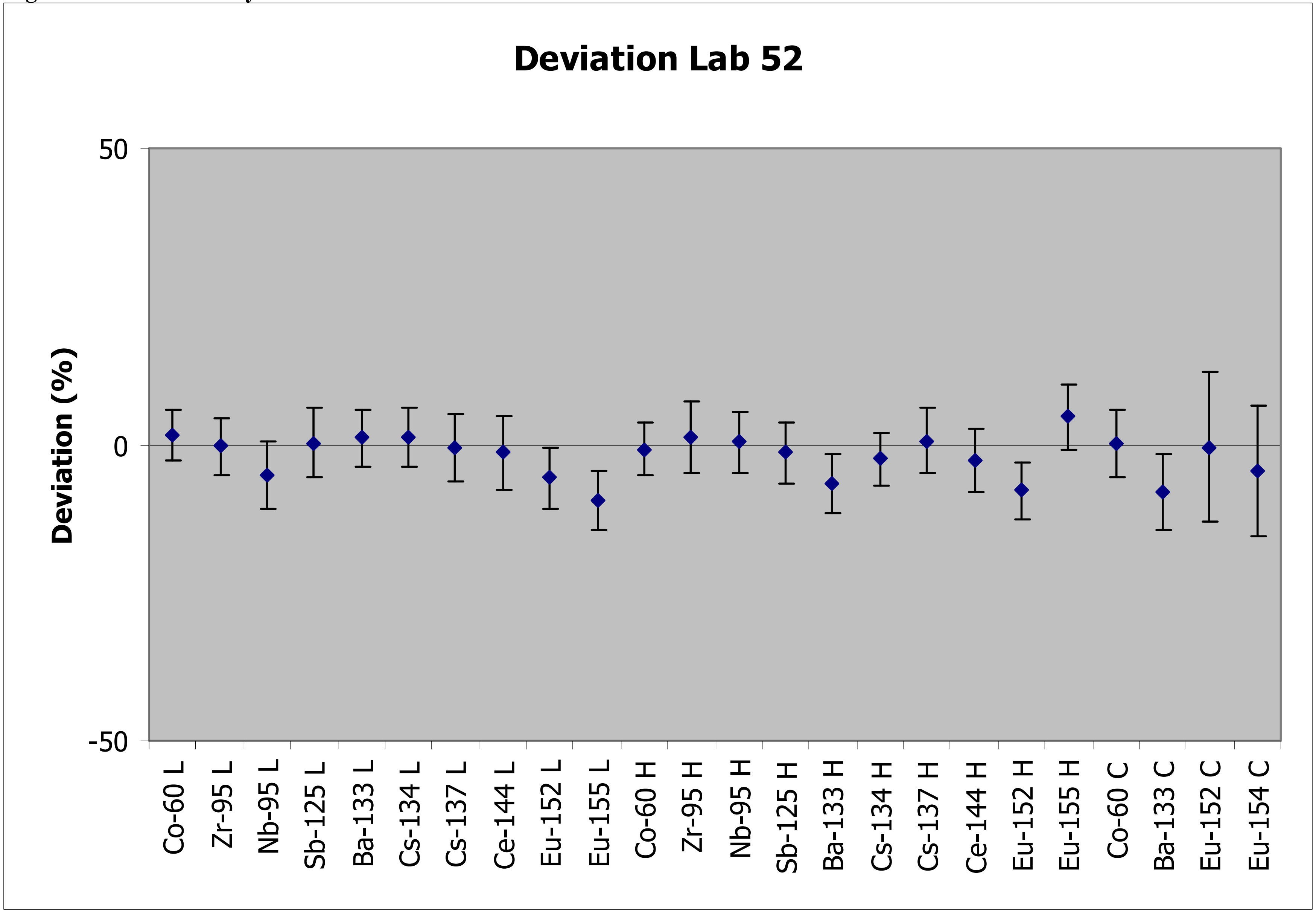


Figure 106 – Laboratory 53

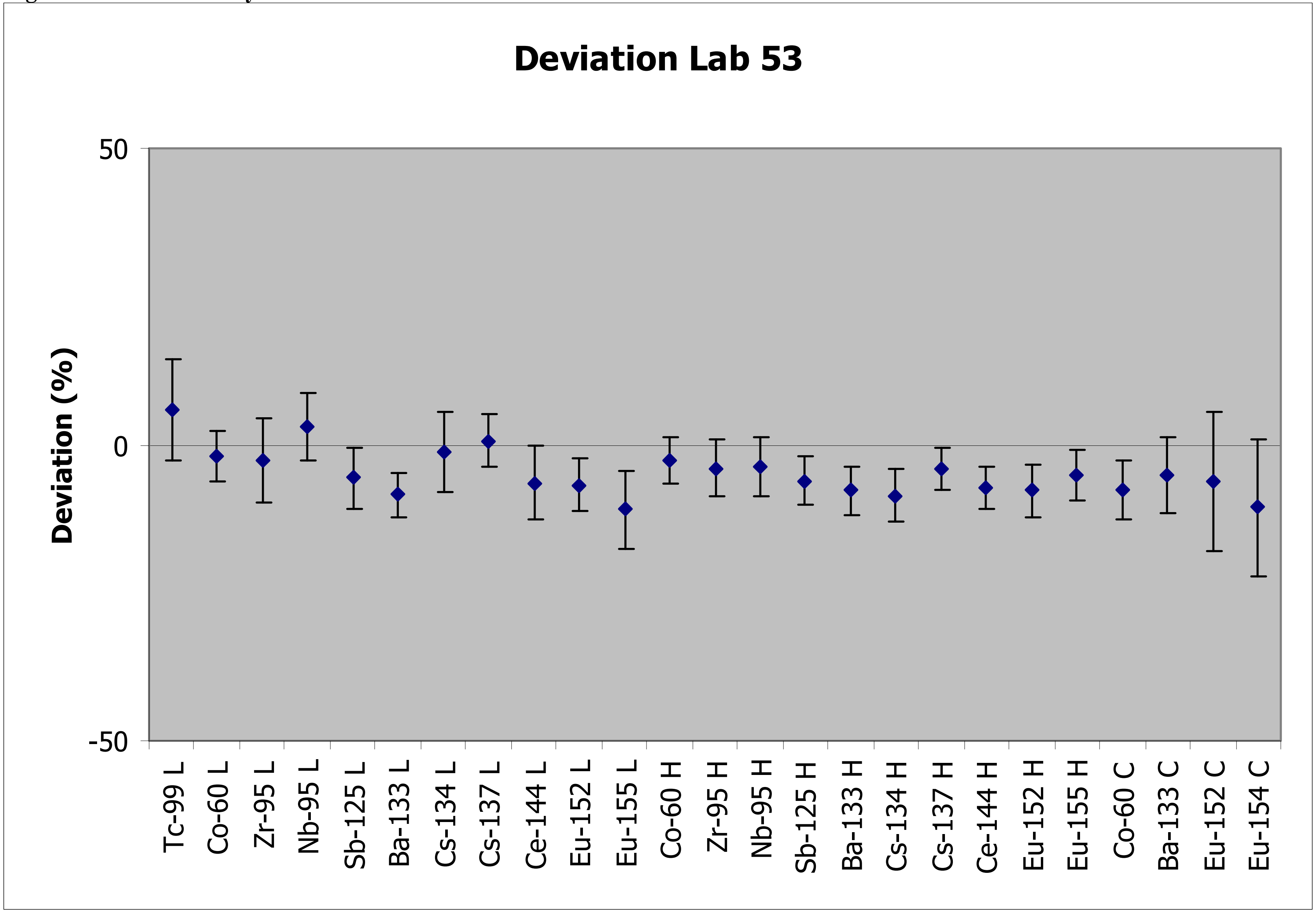


Figure 107 – Laboratory 54

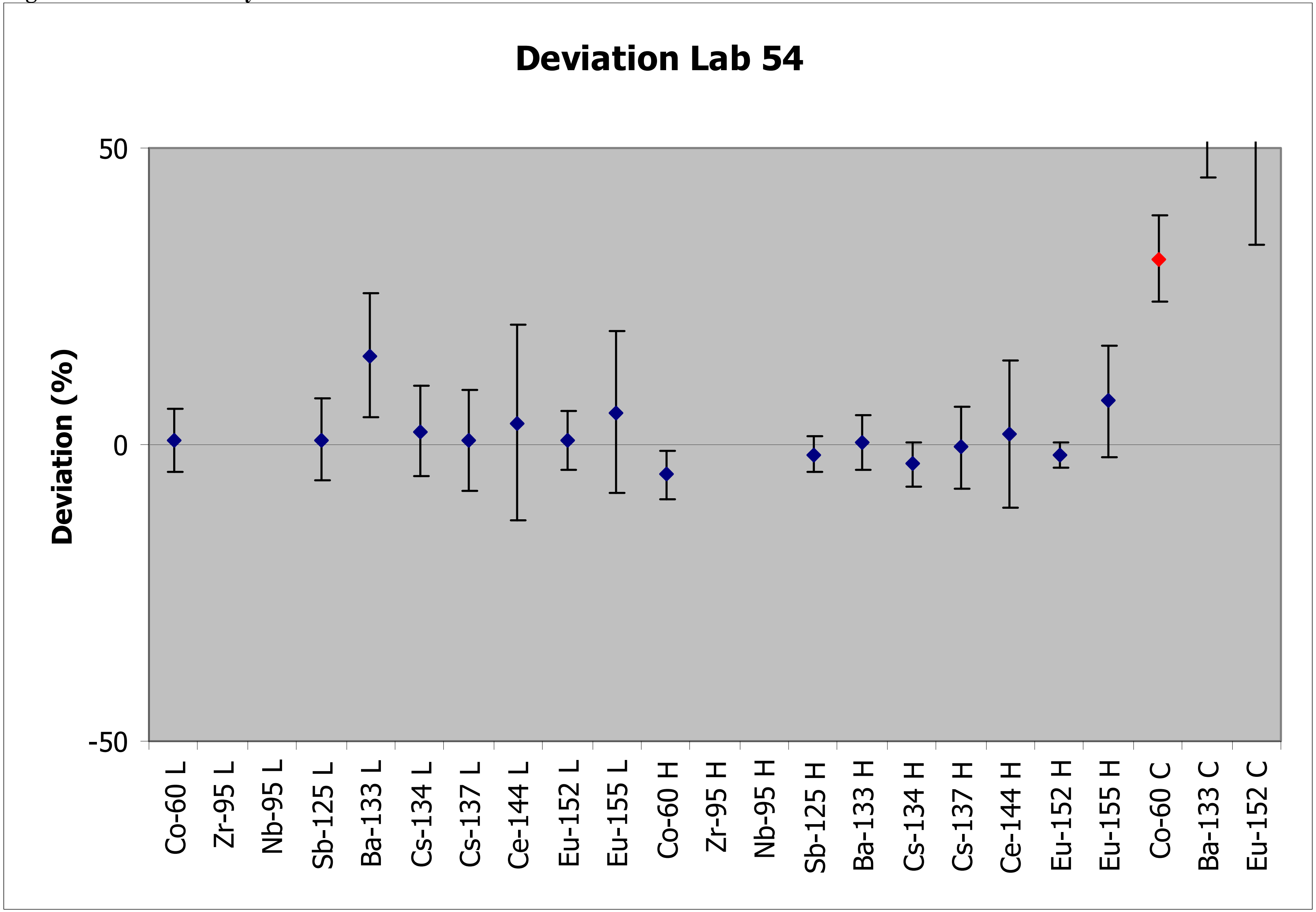


Figure 108 – Laboratory 55

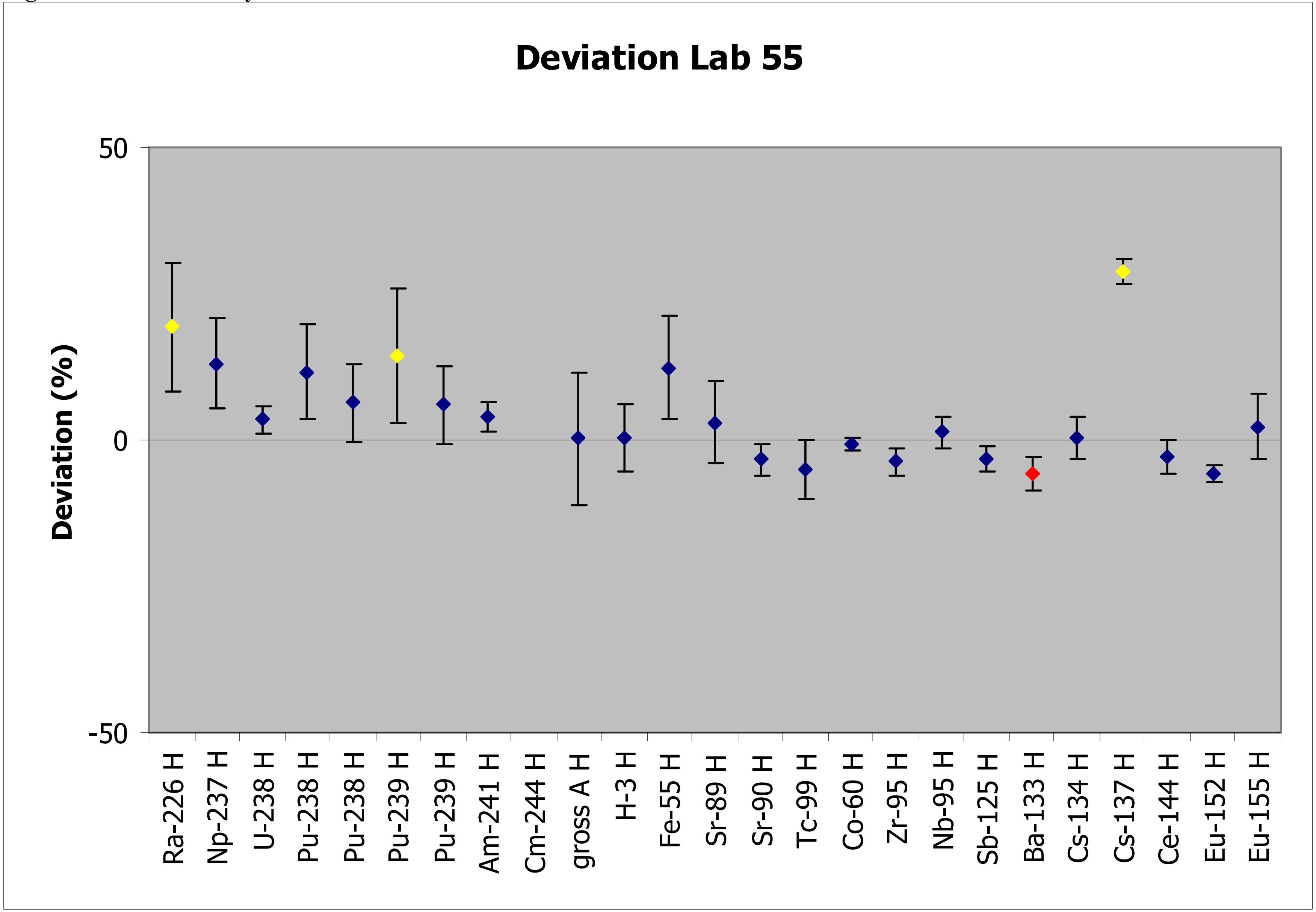


Figure 109 – Laboratory 56

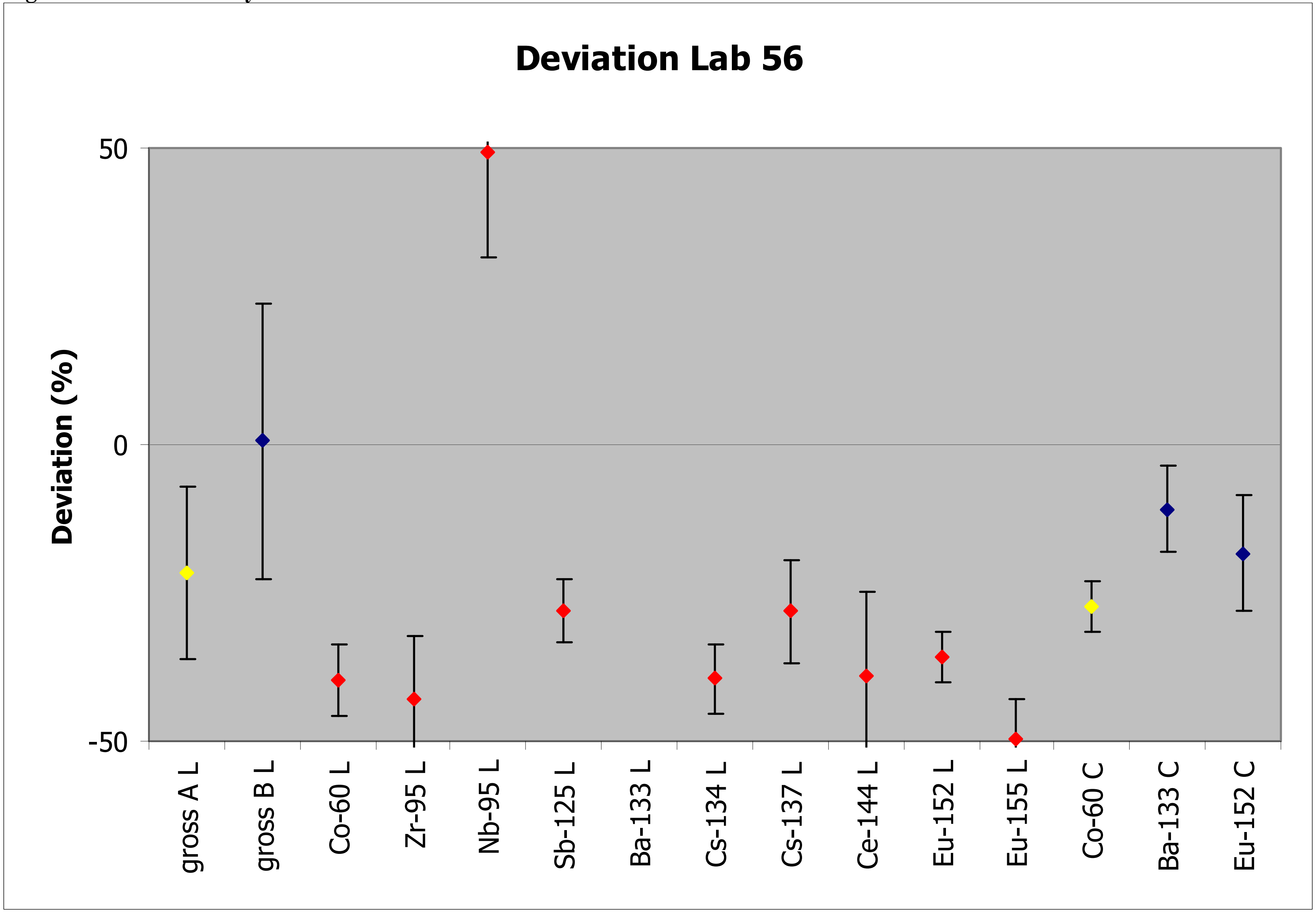


Figure 110 – Laboratory 58

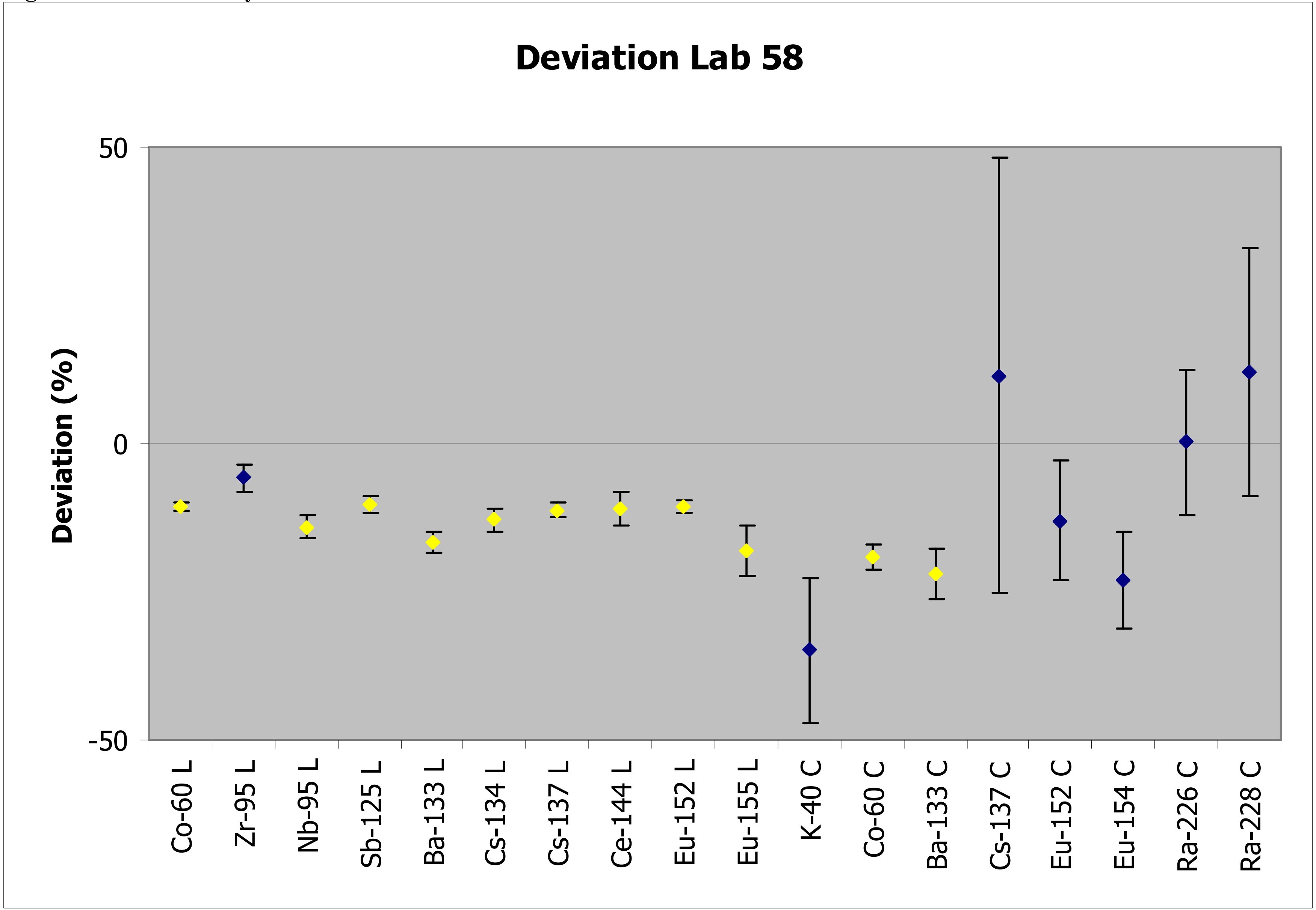


Figure 111 – Laboratory 59

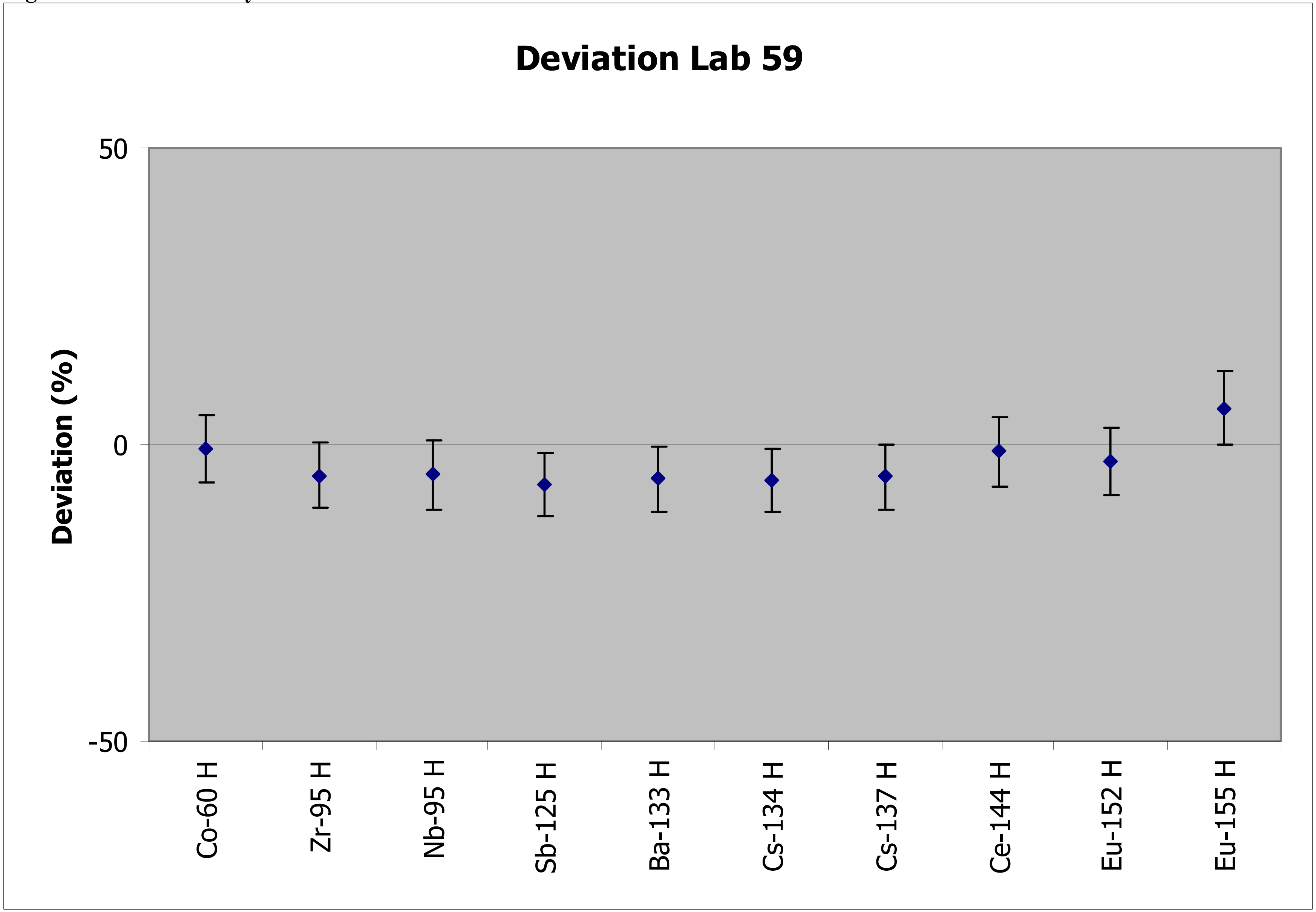


Figure 112 – Laboratory 61

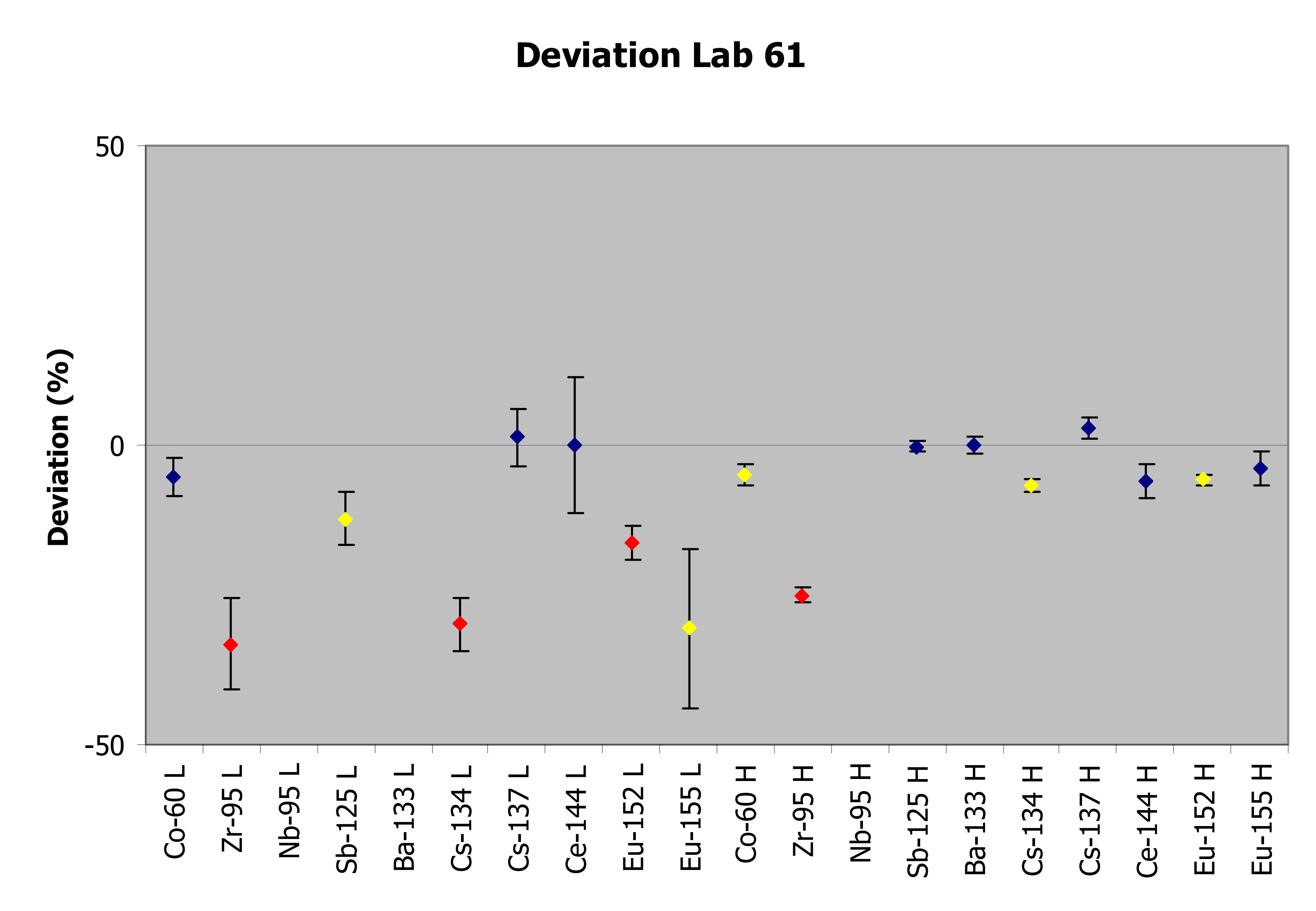


Figure 113 – Laboratory 62

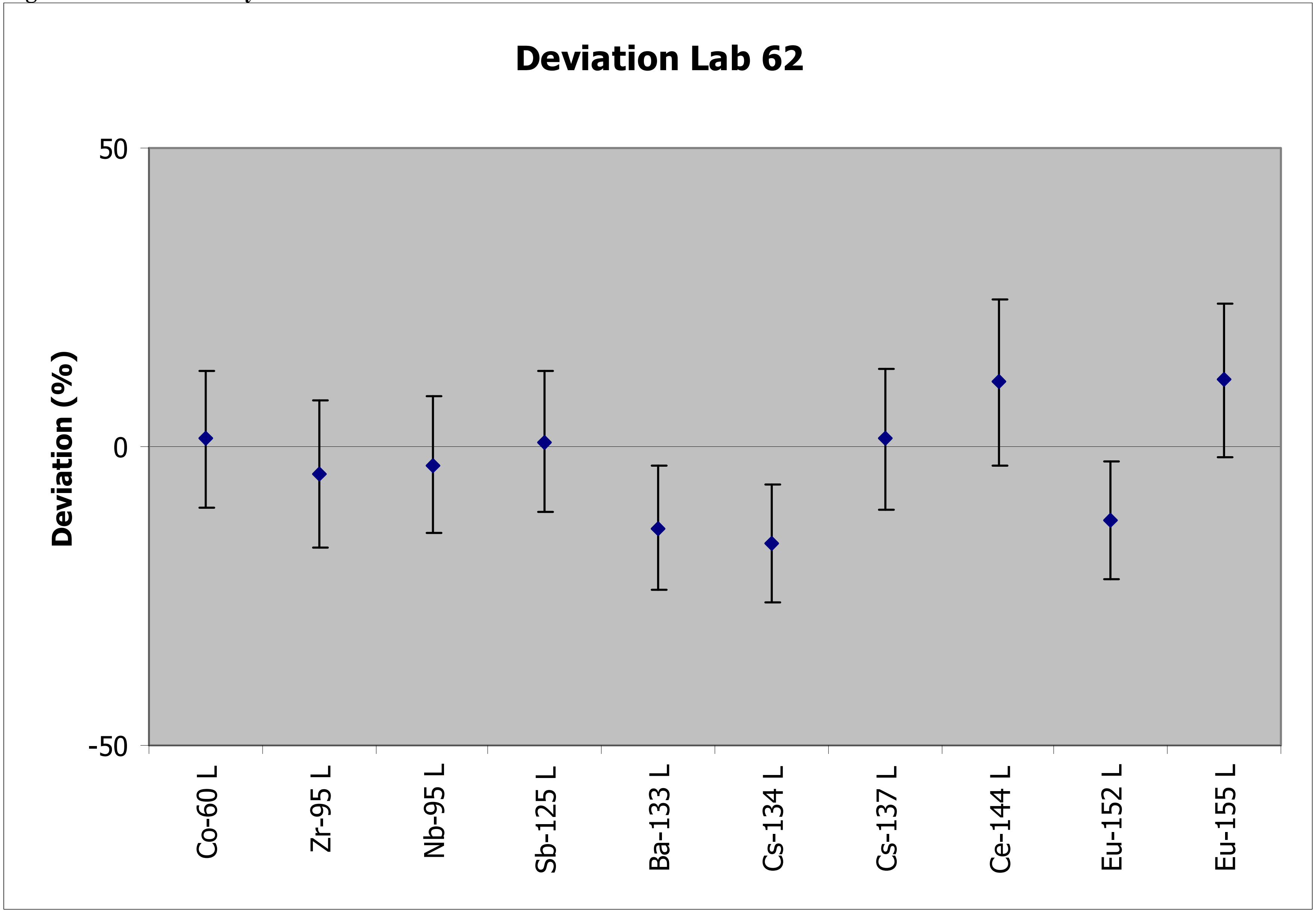


Figure 114 – Laboratory 65

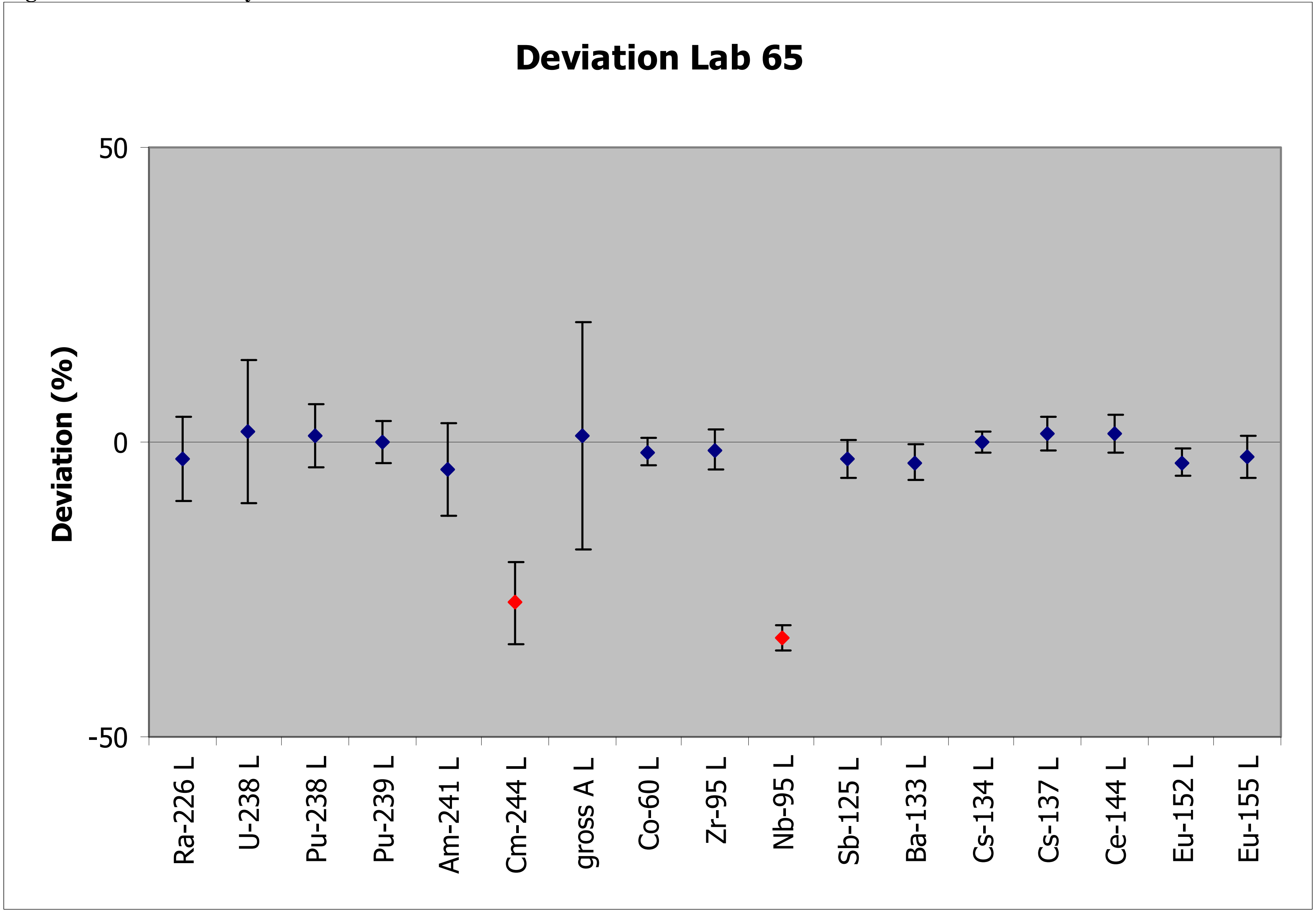


Figure 115 – Laboratory 66

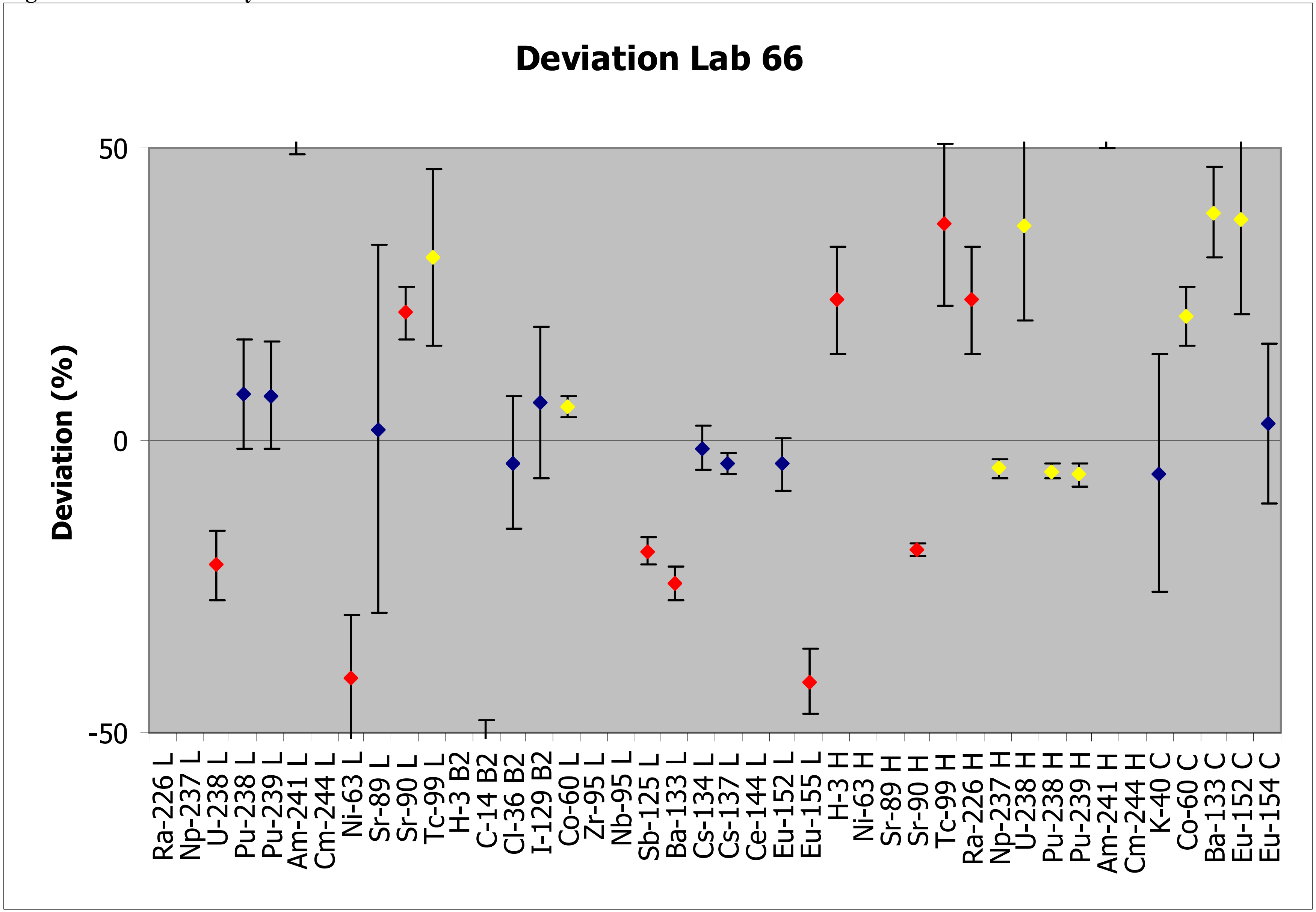


Figure 116 – Laboratory 67

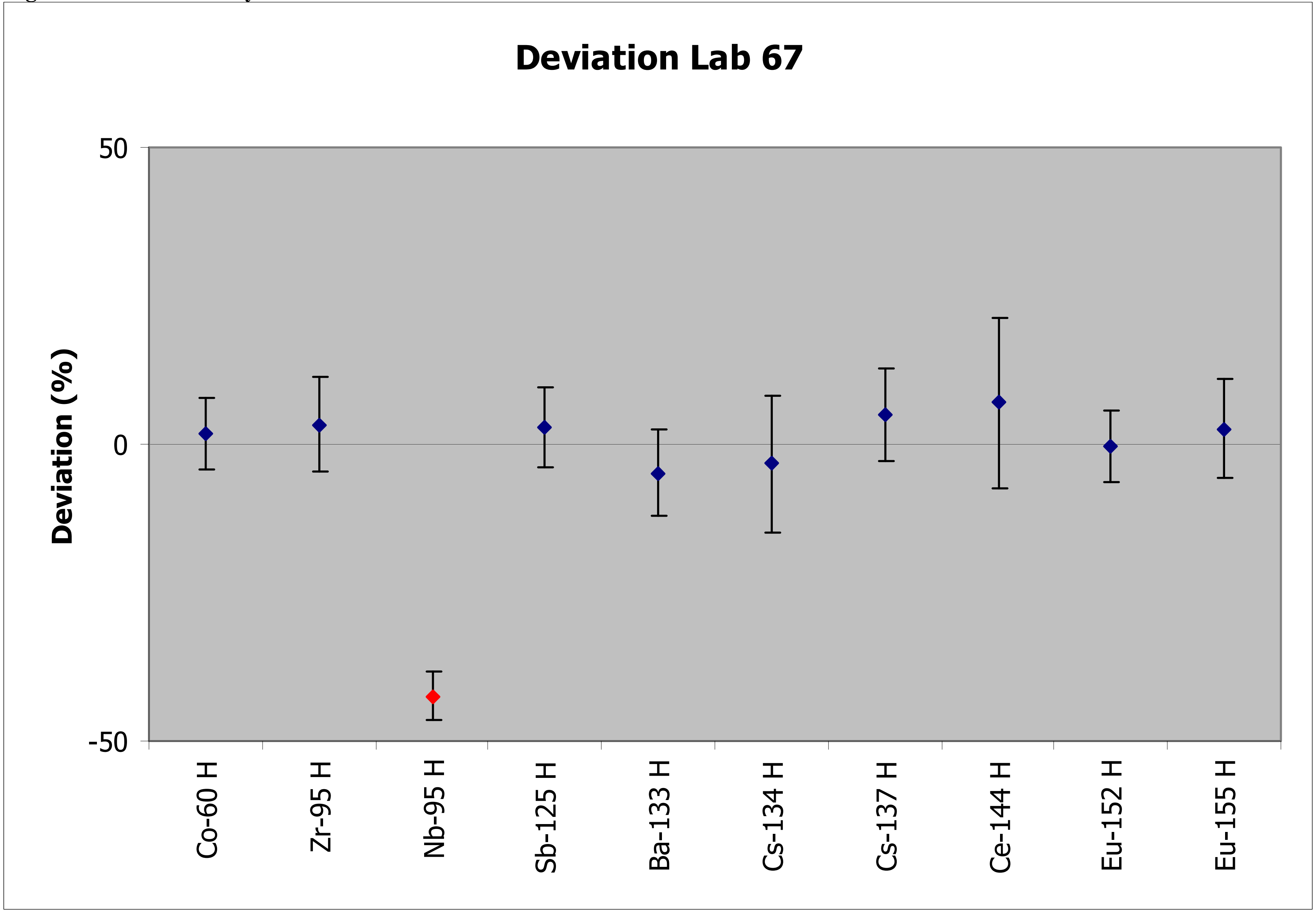


Figure 117 – Laboratory 68

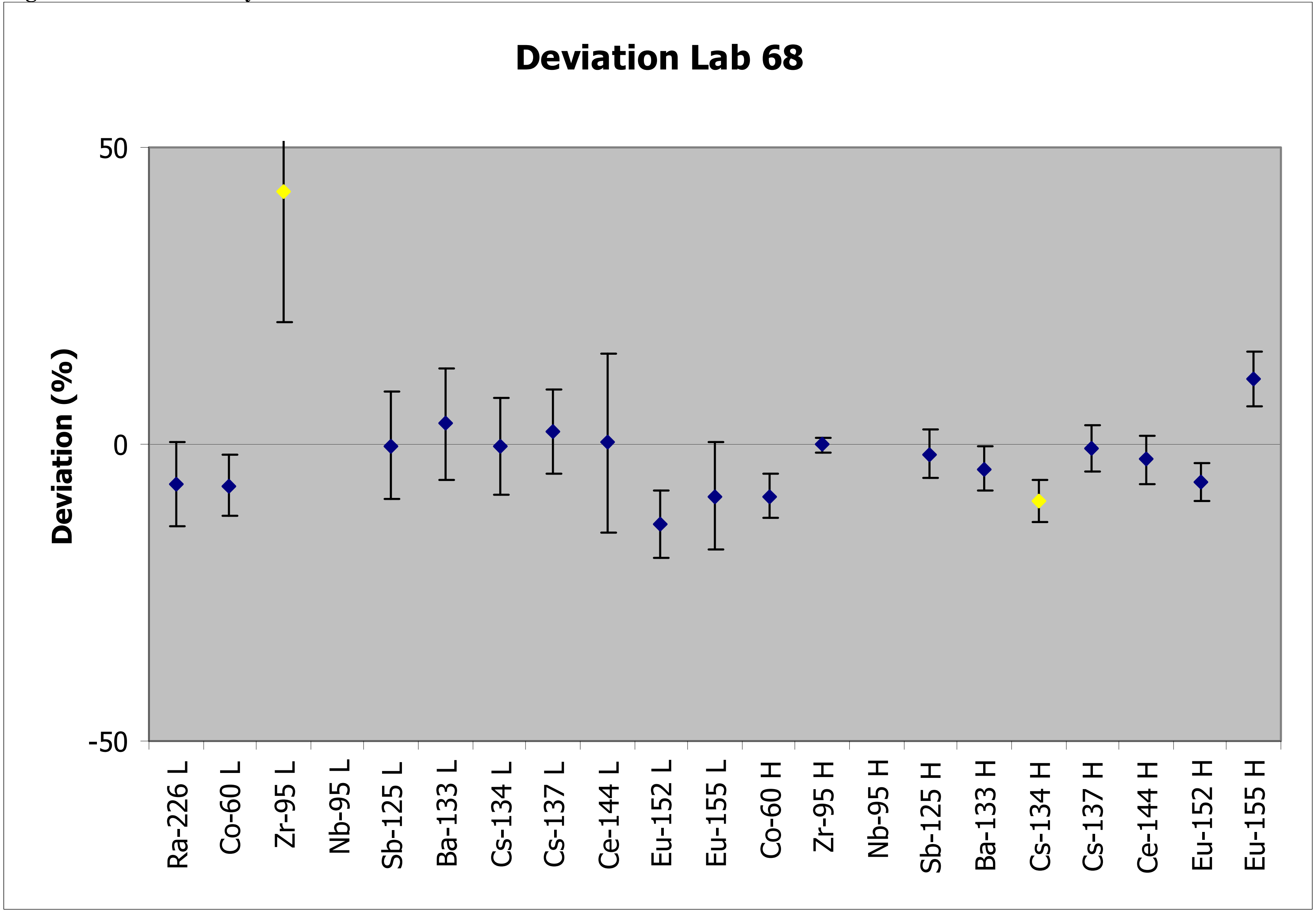


Figure 118 – Laboratory 69

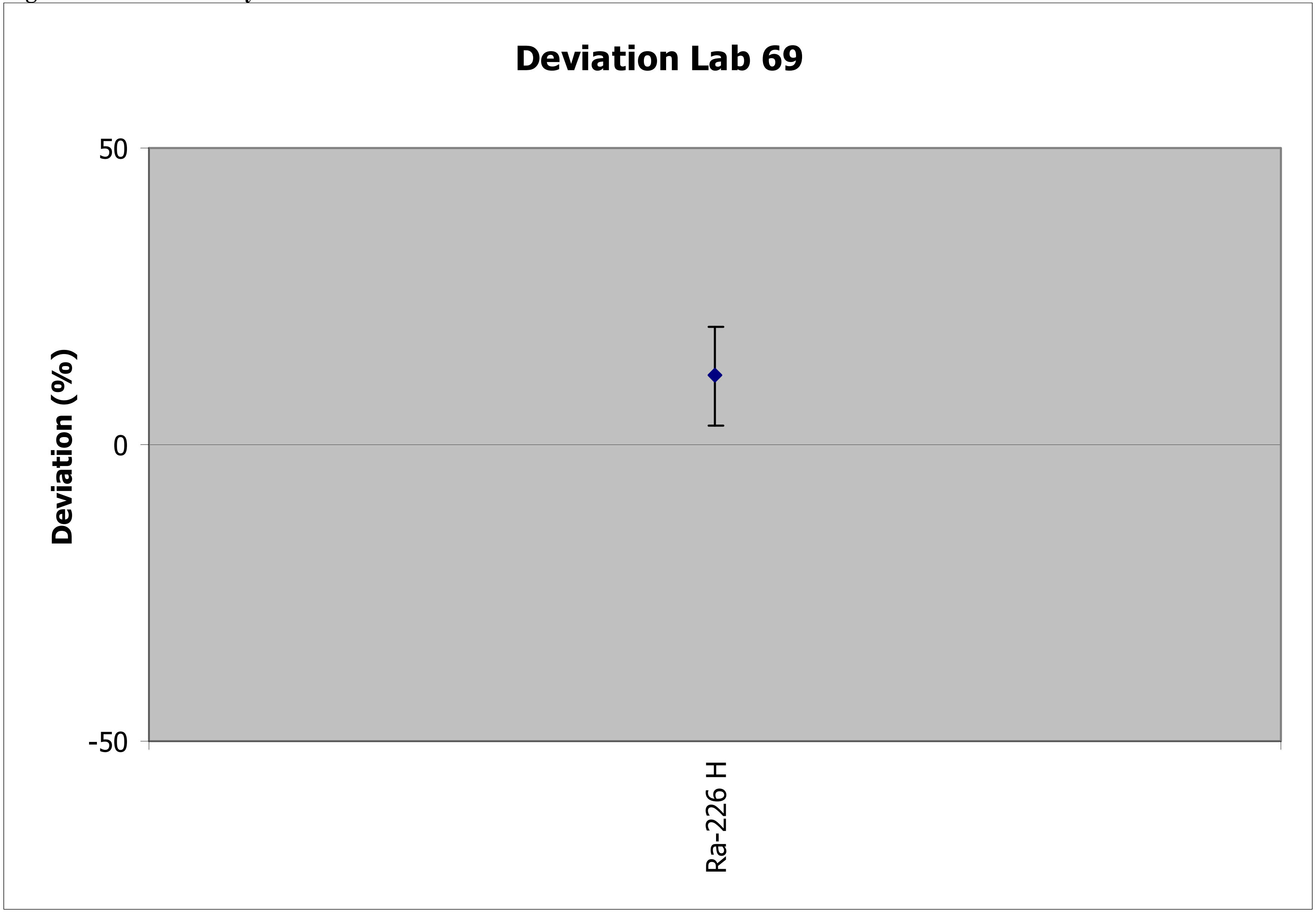


Figure 119 – Laboratory 71

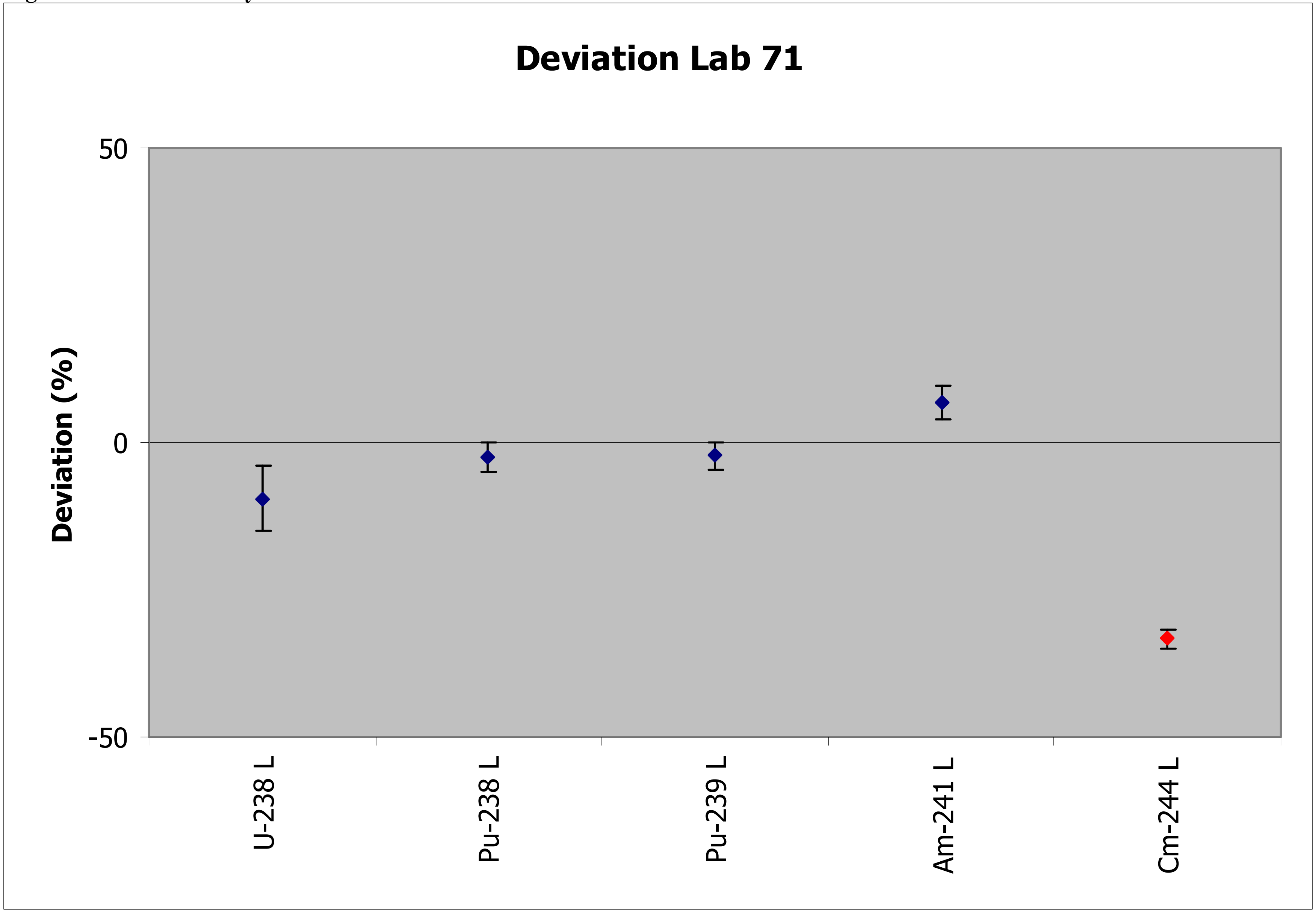


Figure 120 – Laboratory 72

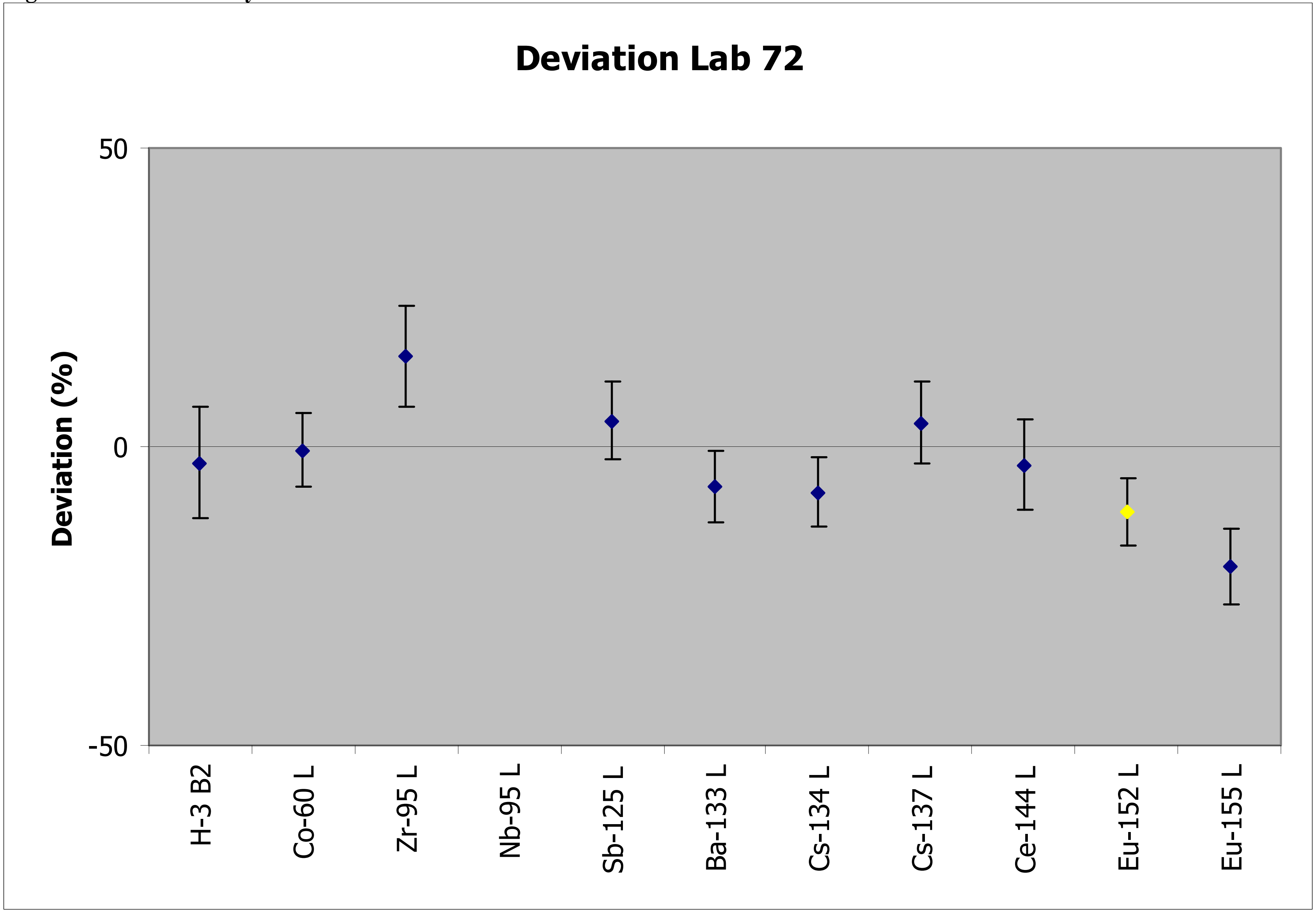


Figure 121 – Laboratory 73

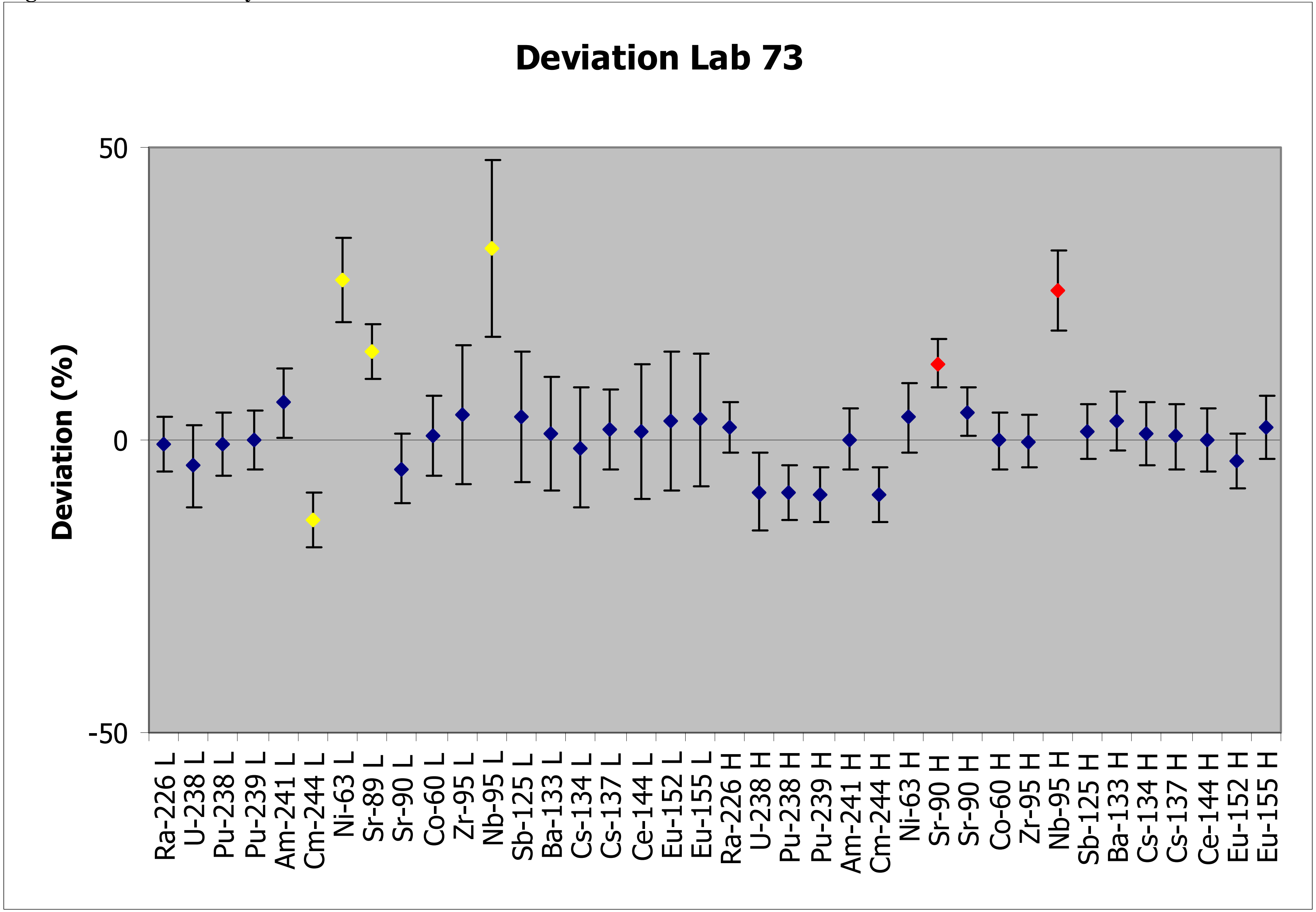


Figure 122 – Laboratory 74

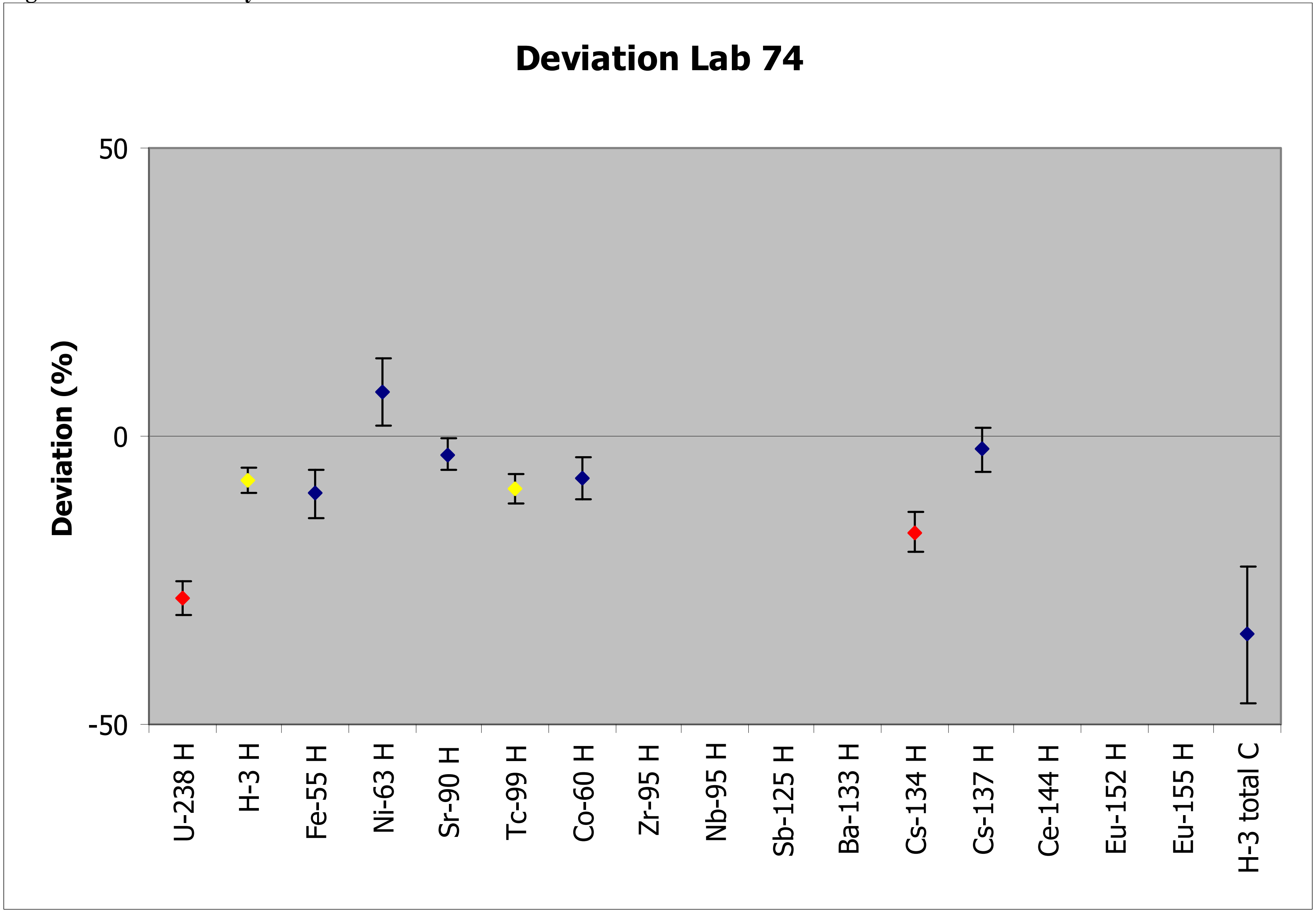


Figure 123 – Laboratory 75

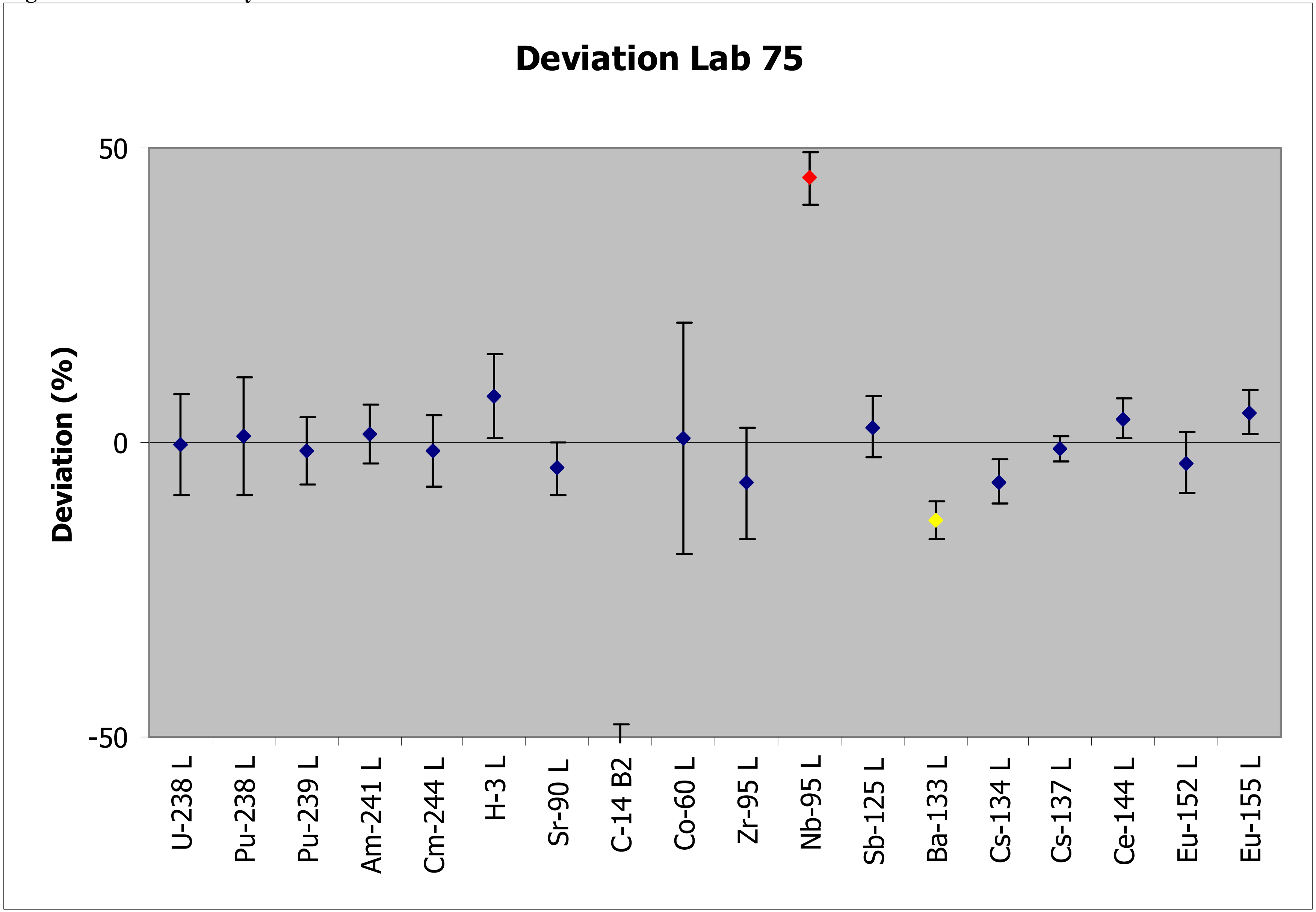


Figure 124 – Laboratory 76

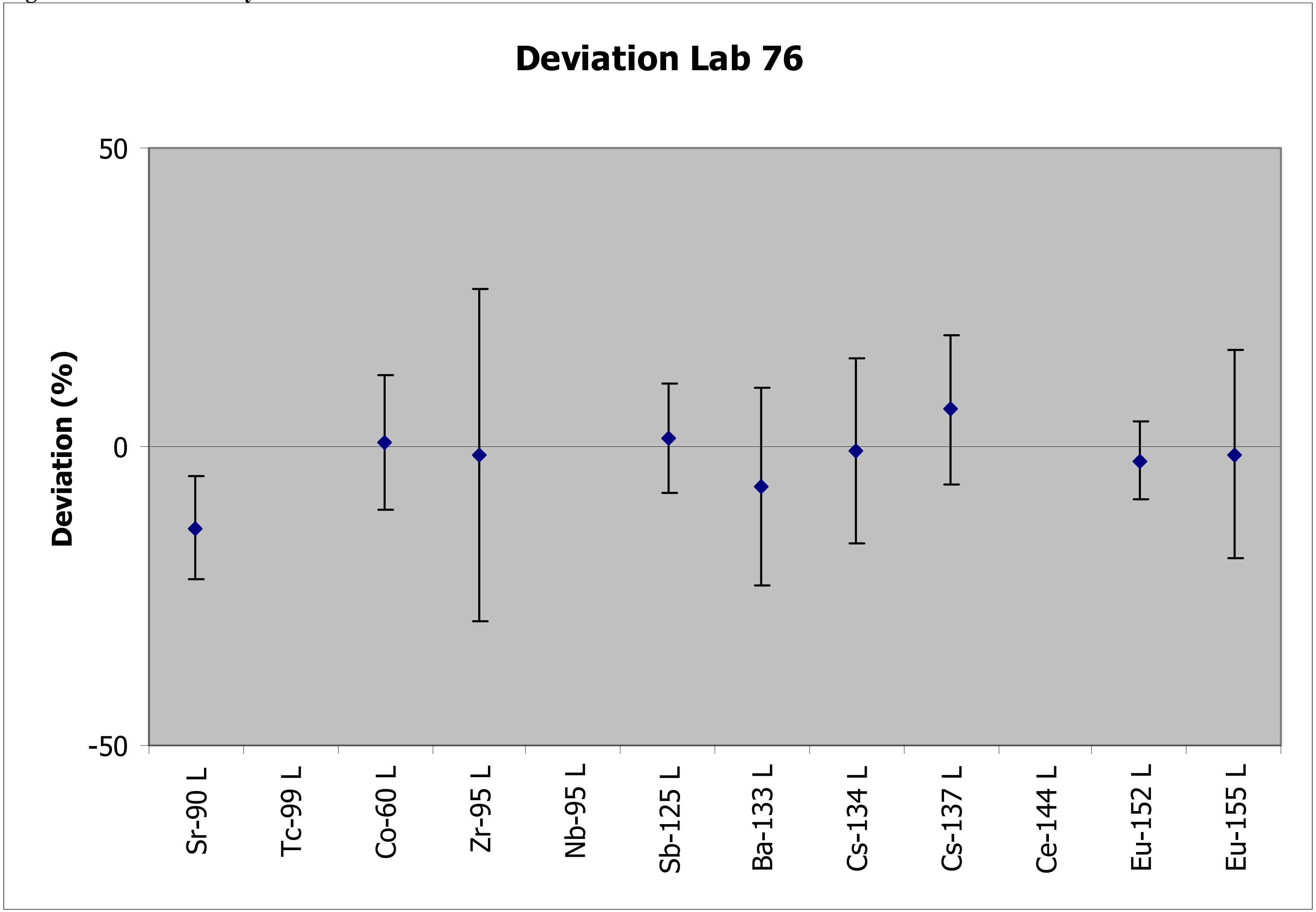


Figure 125 – Laboratory 77

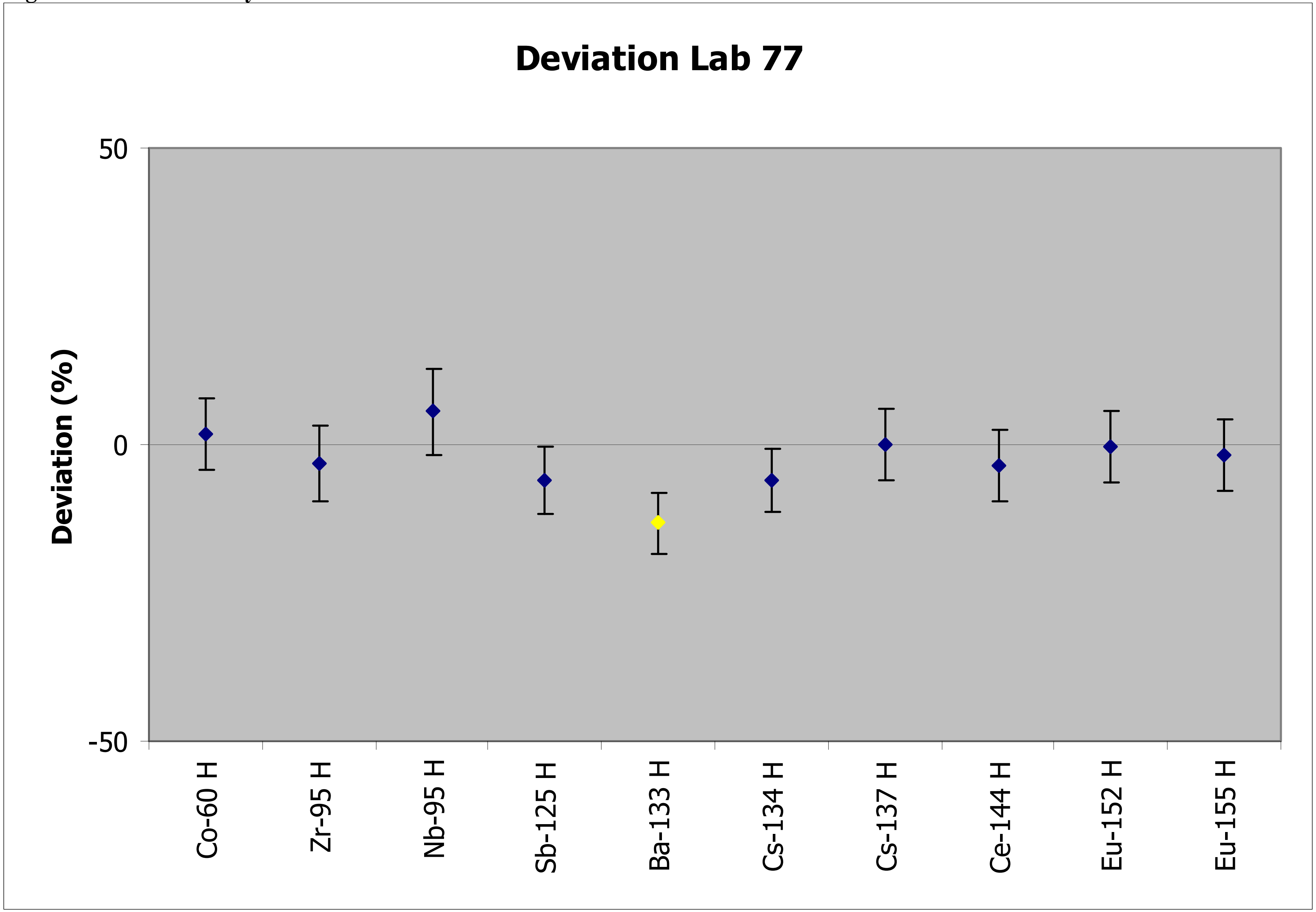


Figure 126 – Laboratory 78

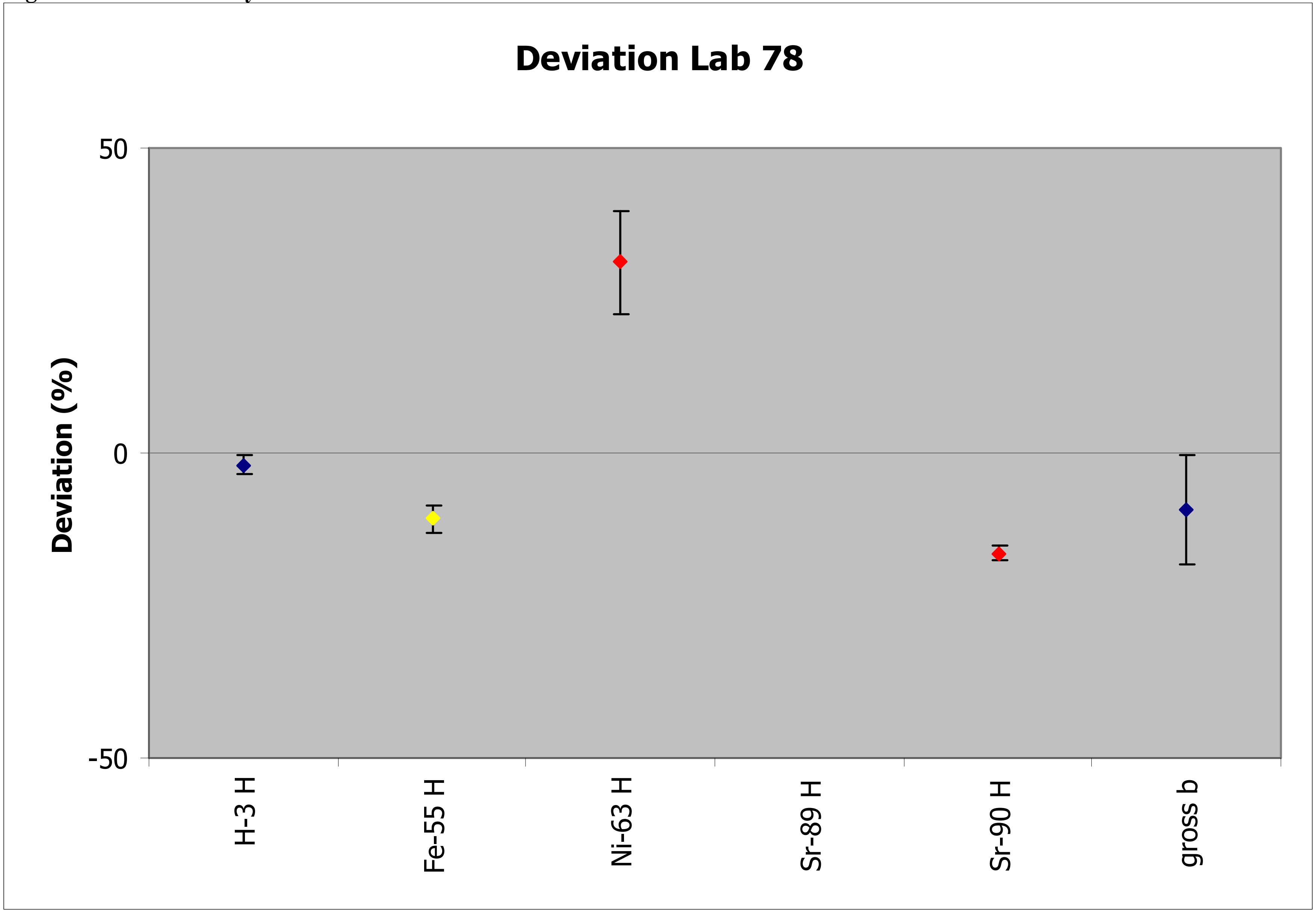


Figure 127 – Laboratory 79

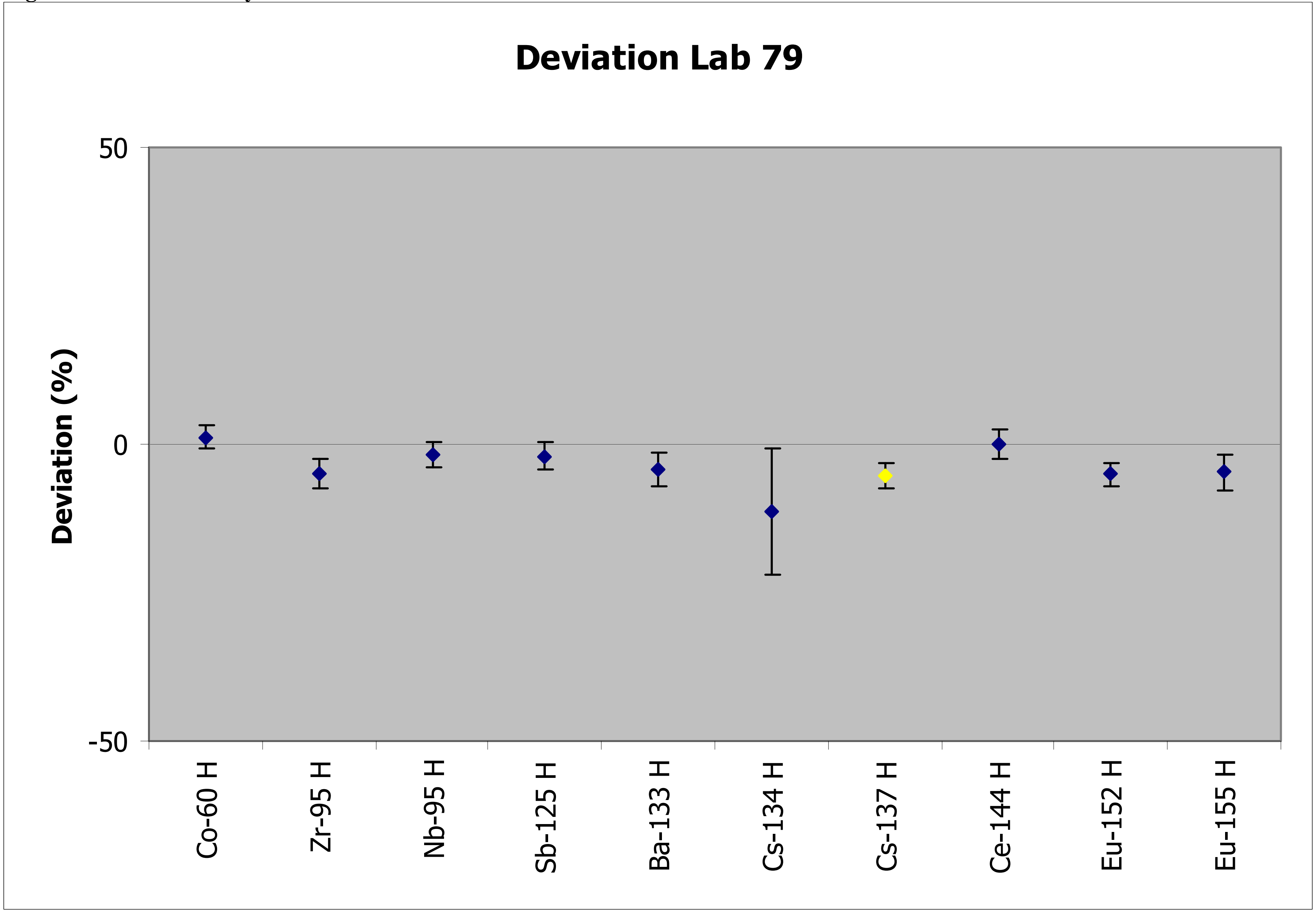


Figure 128 – Laboratory 80

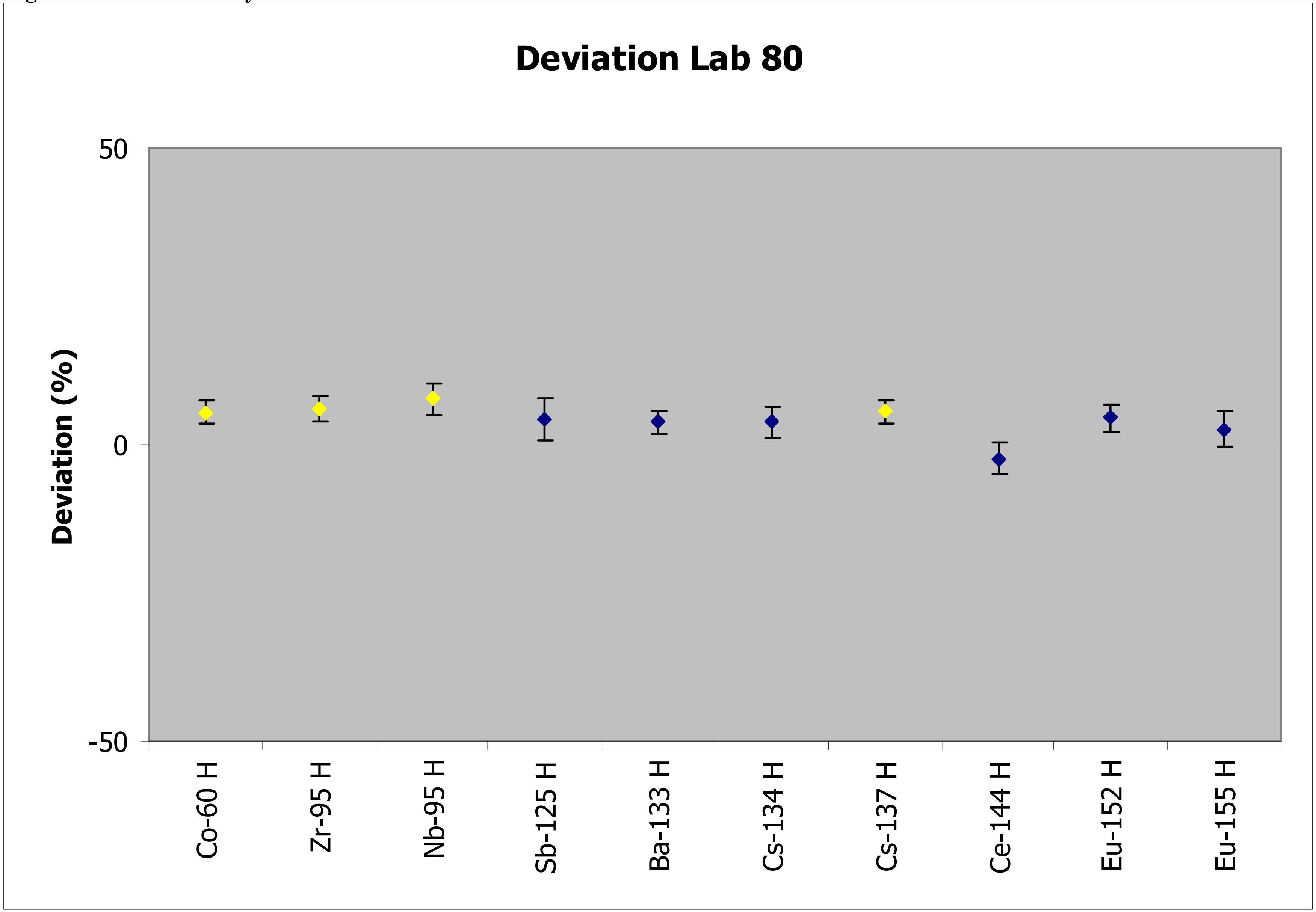


Figure 129 – Laboratory 81

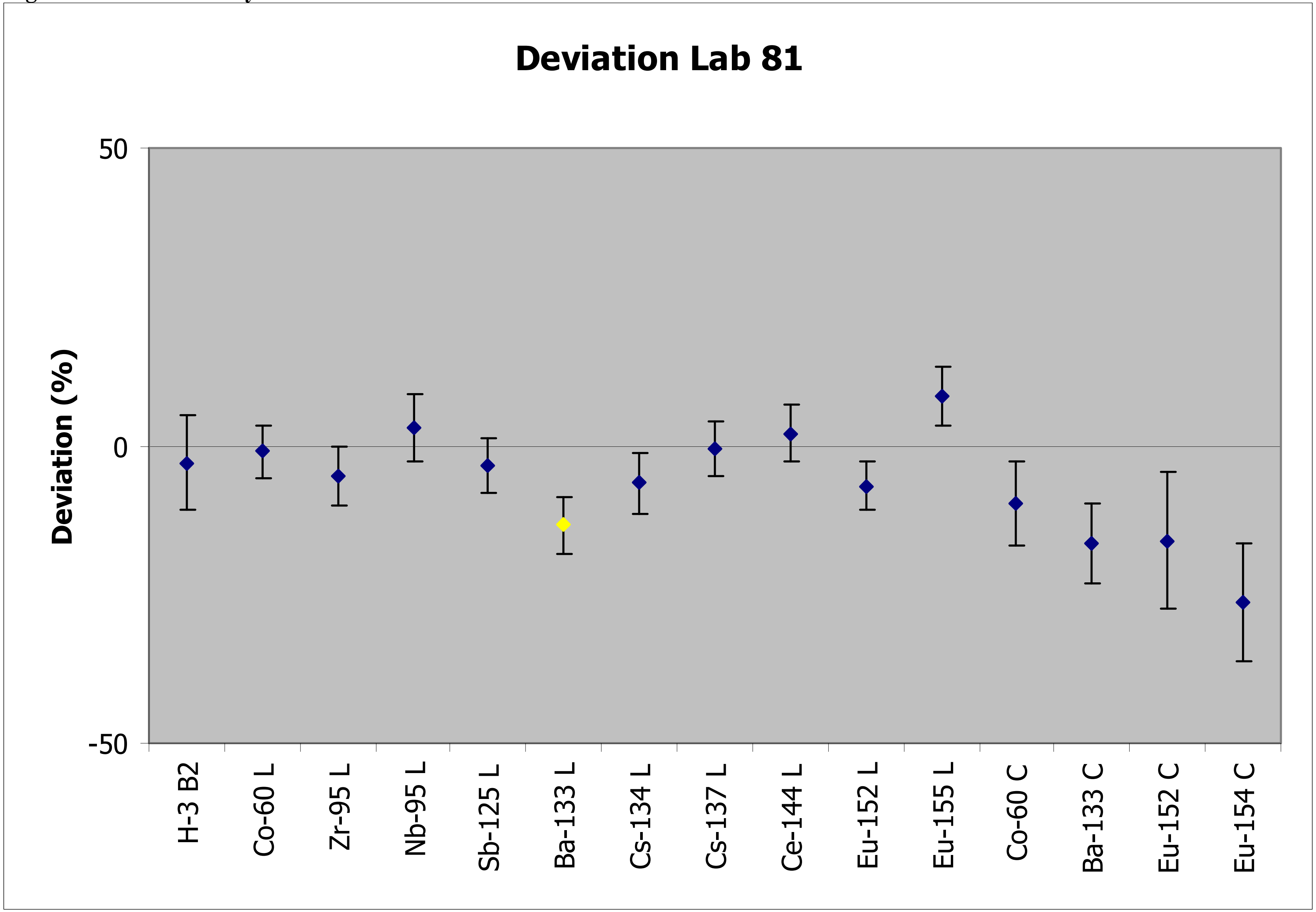


Figure 130 – Laboratory 82

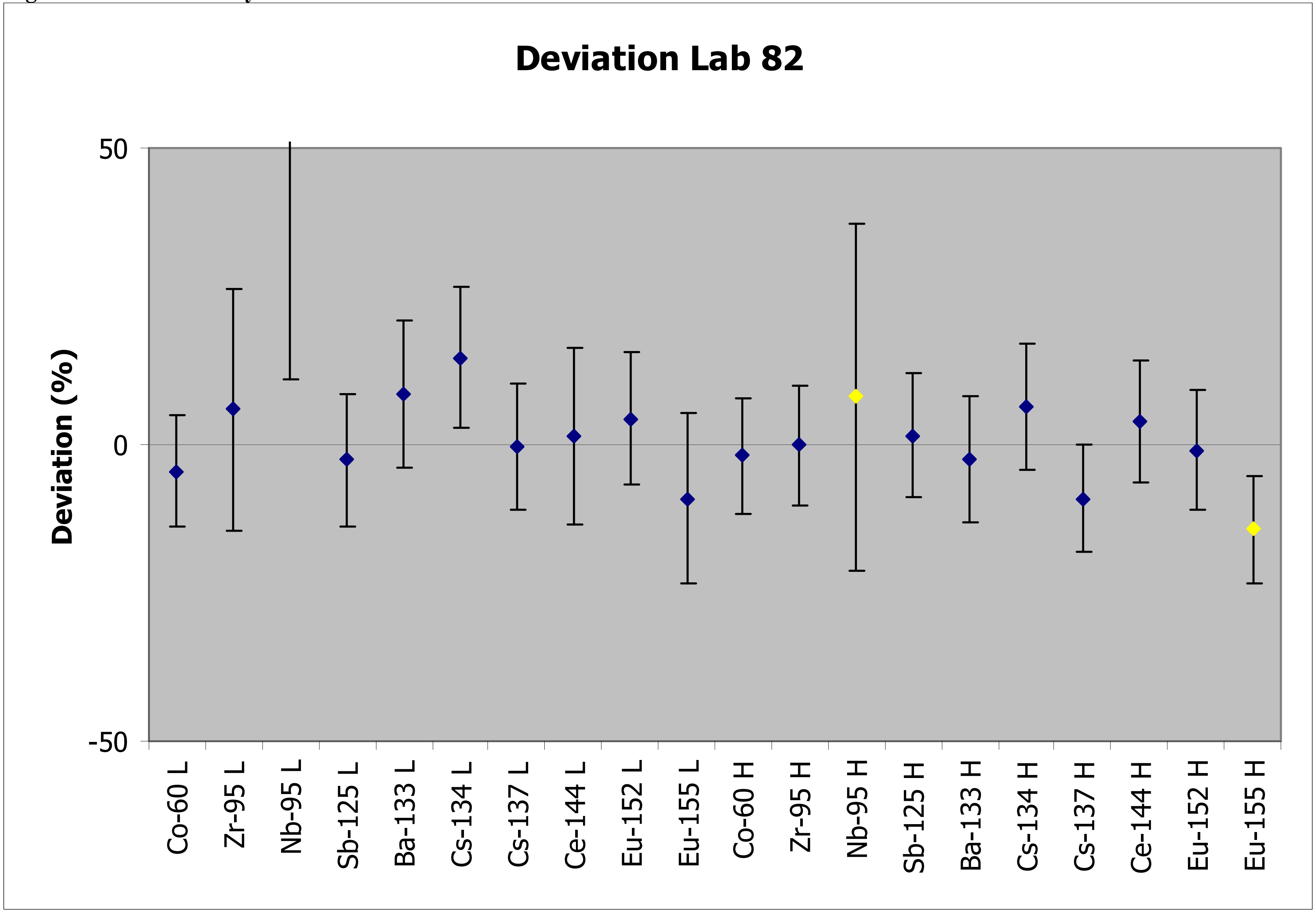


Figure 131 – Laboratory 83

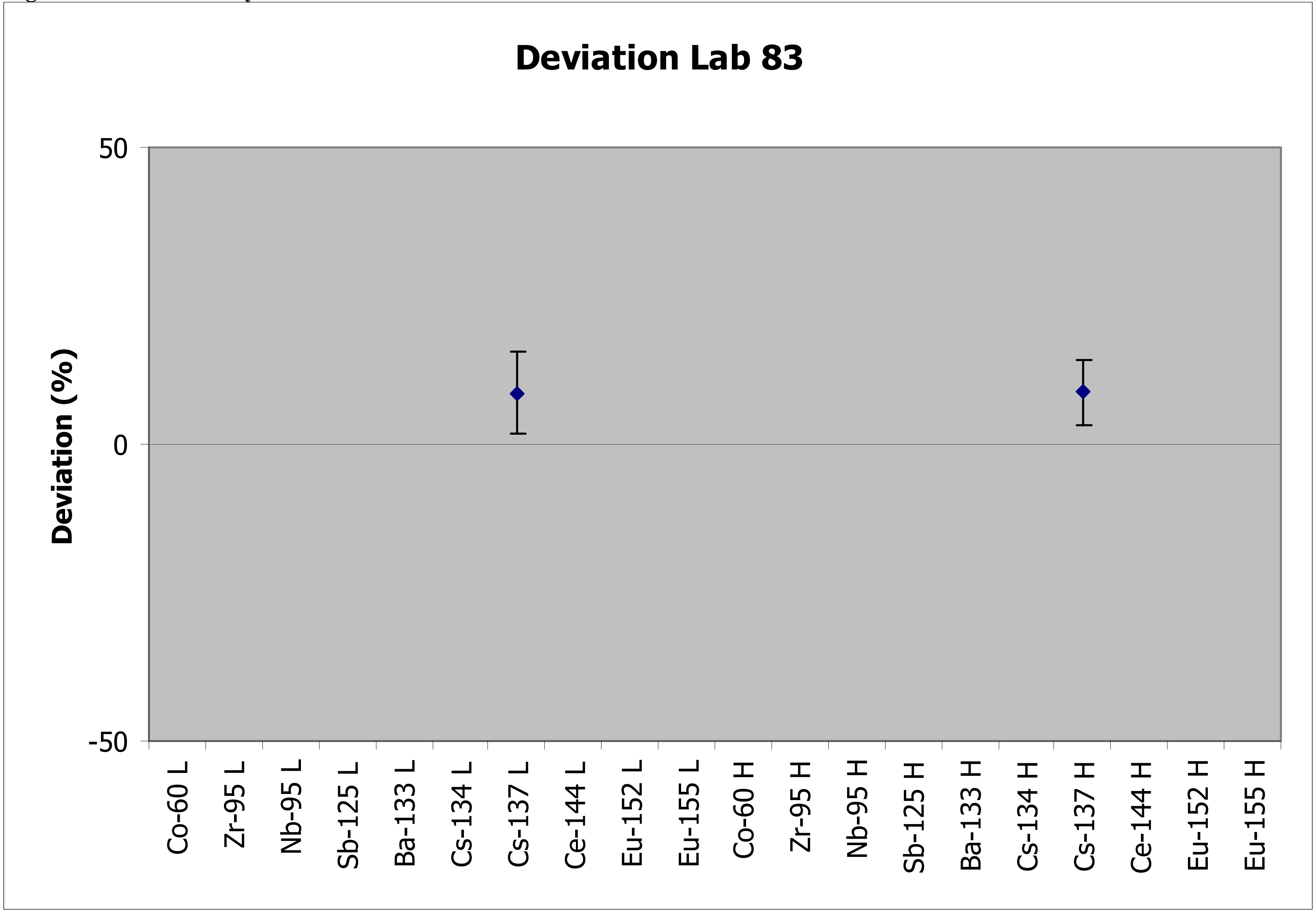


Figure 132 – Laboratory 84

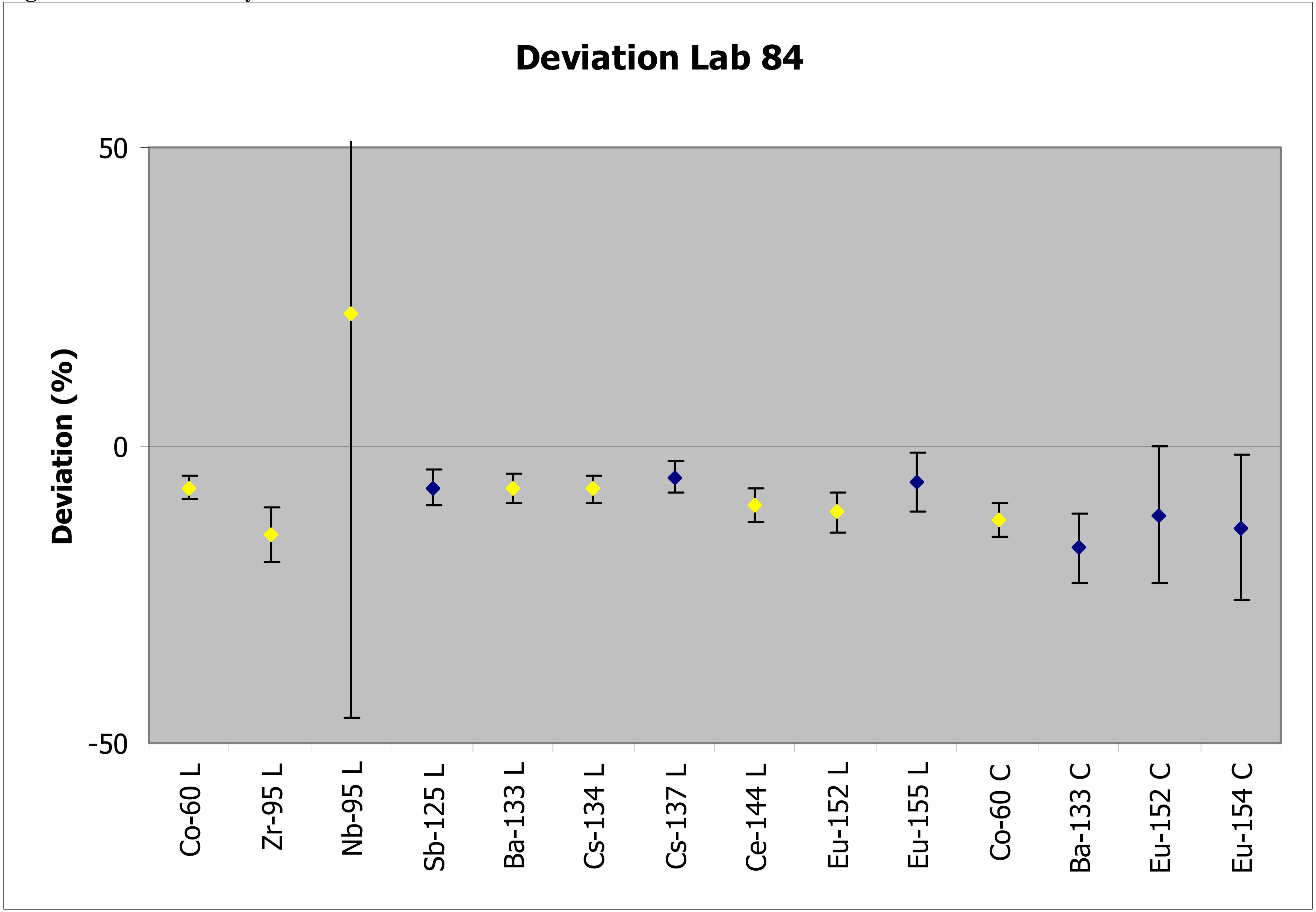


Figure 133 – Laboratory 85

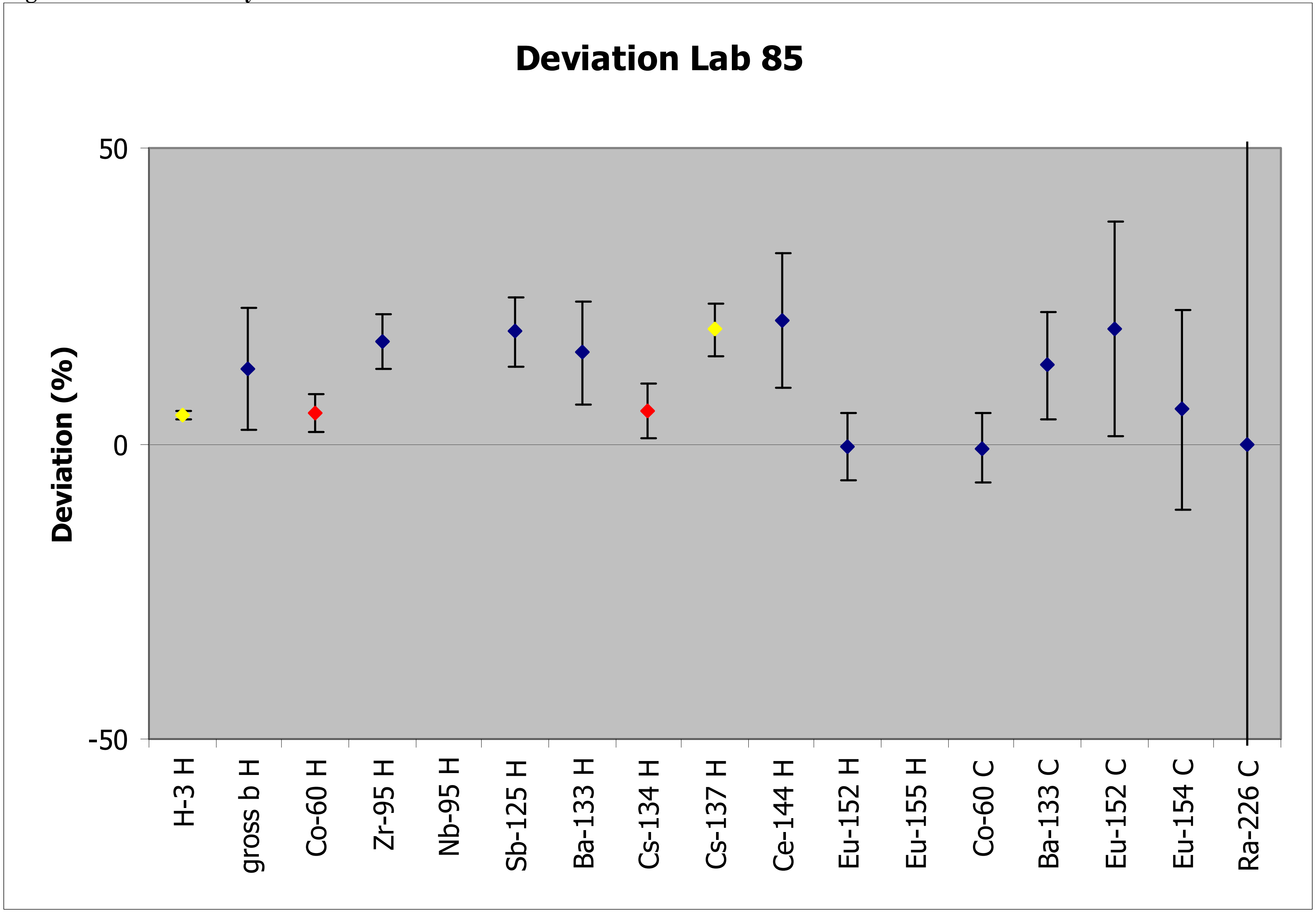


Figure 134 – Laboratory 86

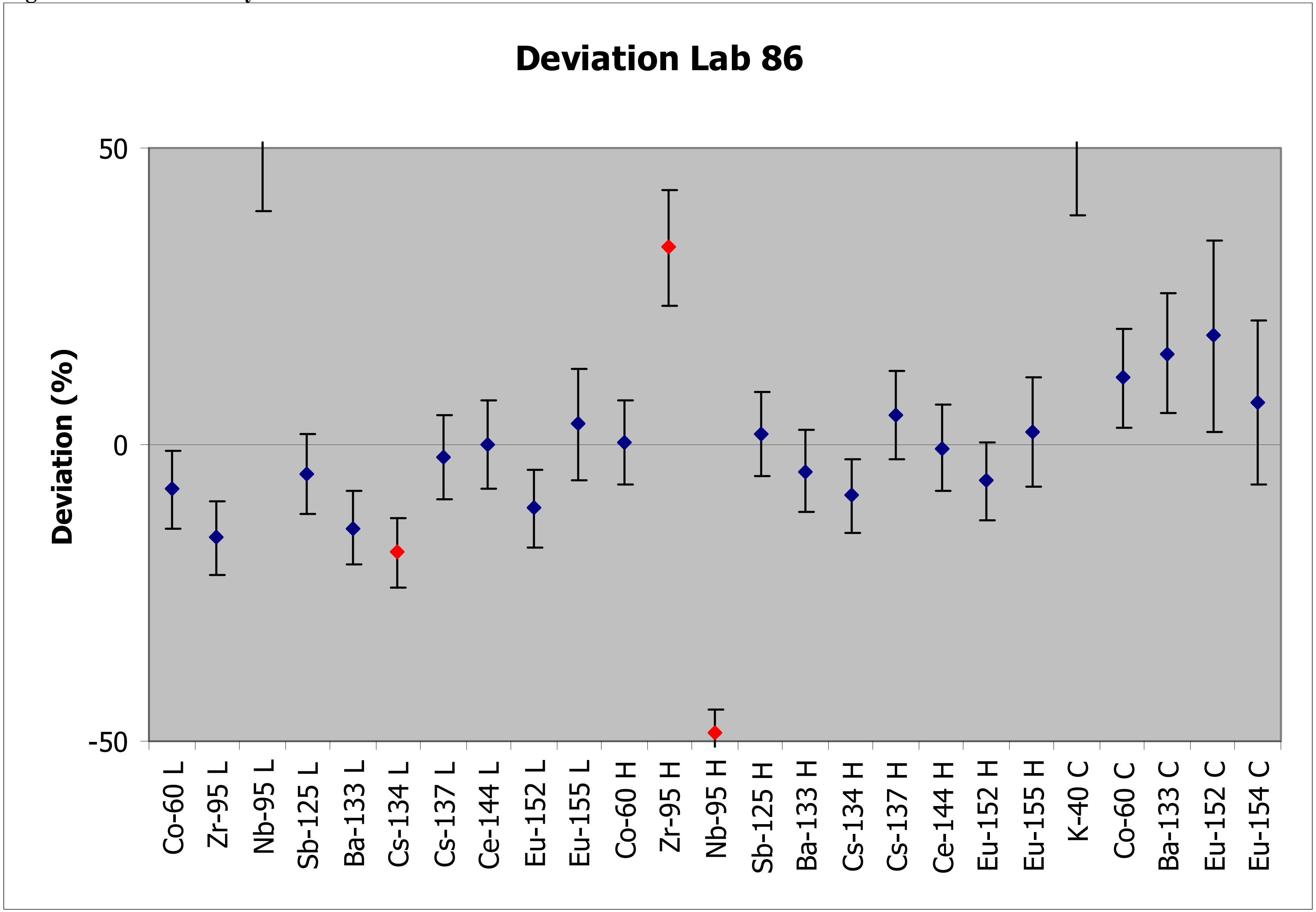


Figure 135 – Laboratory 87

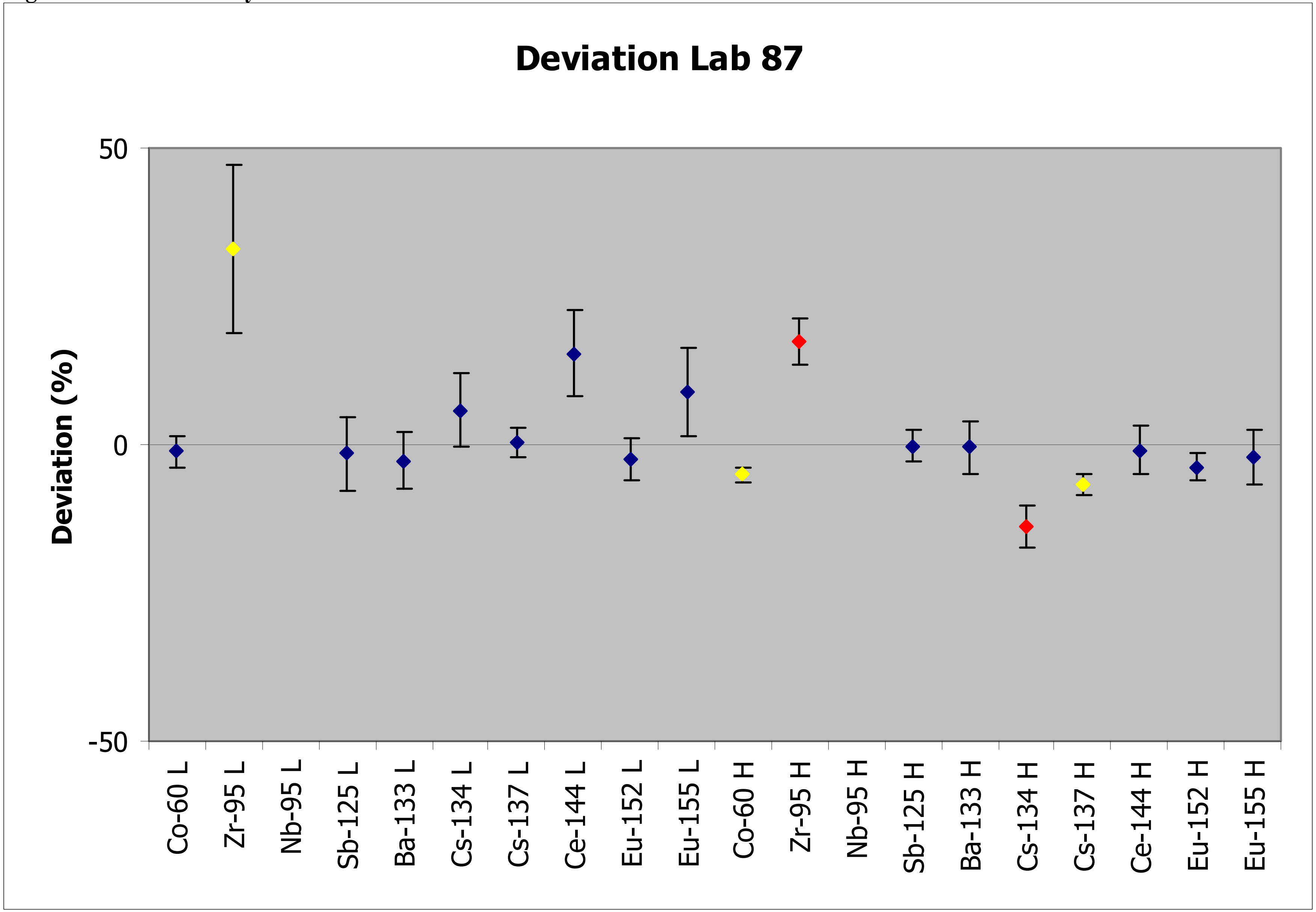


Figure 136 – Median relative uncertainties

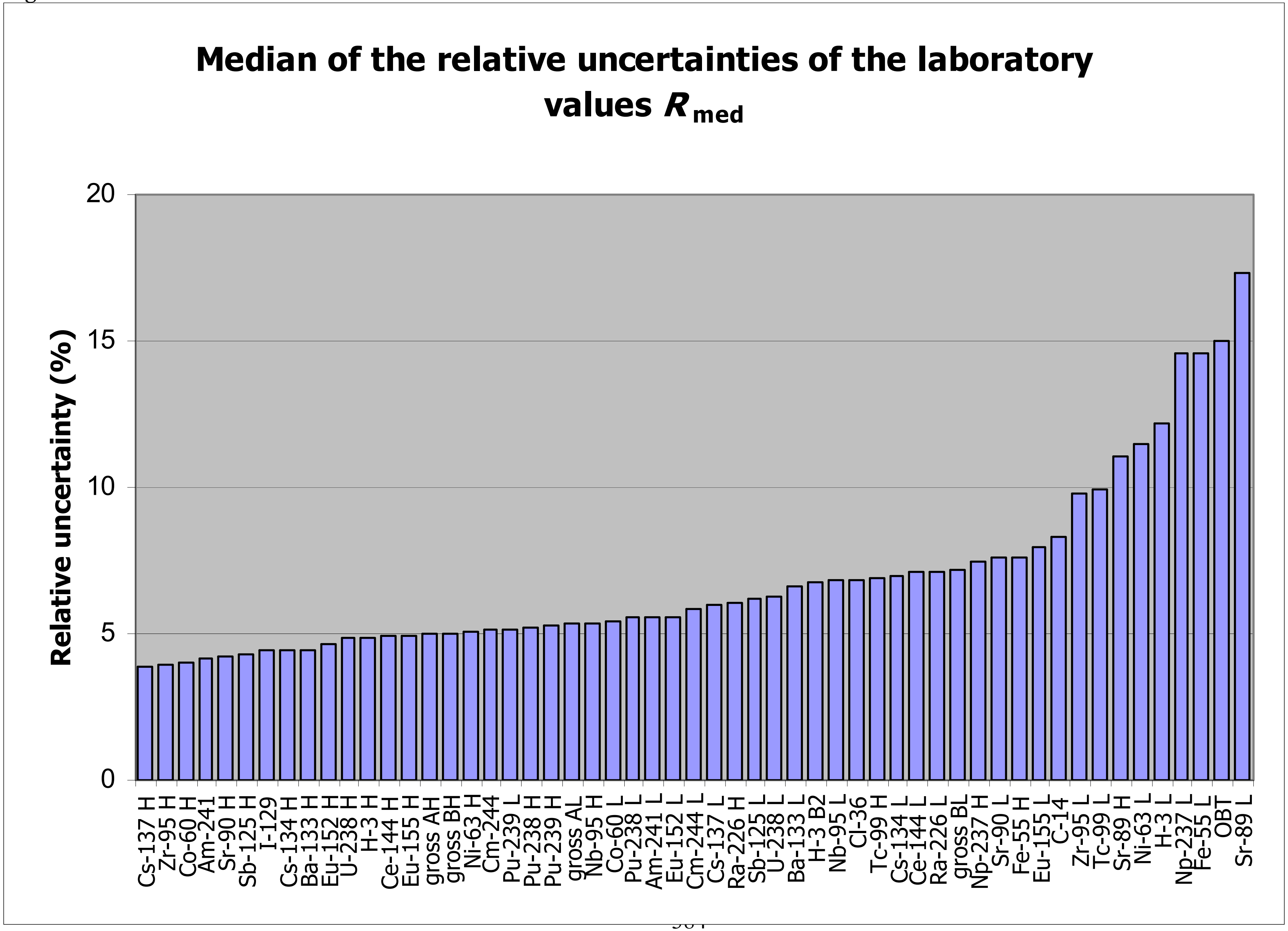


Figure 137 – Outlier limits relative uncertainties

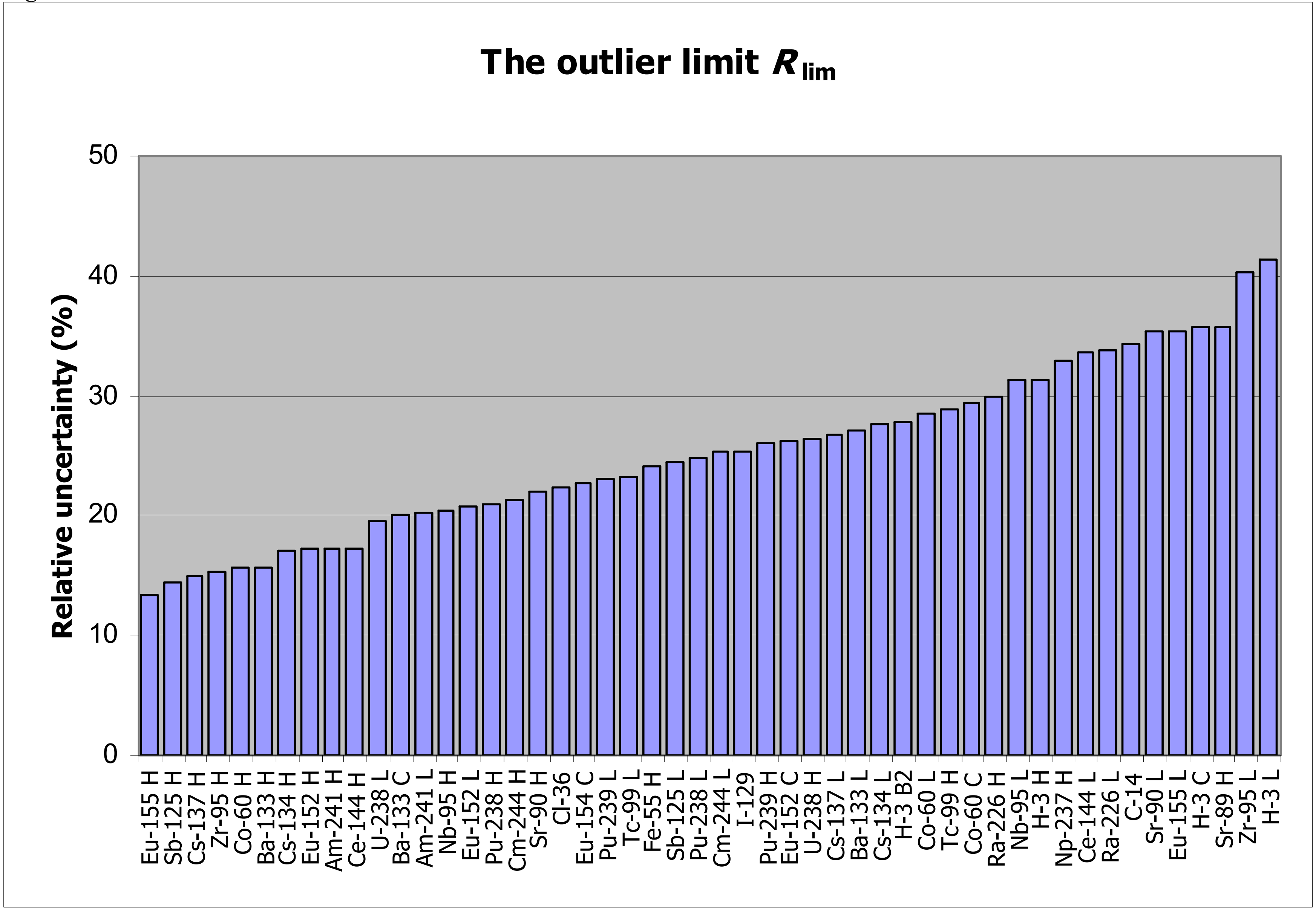


Figure 138A – Normalised ^{244}Cm / ^{241}Am ratios AL

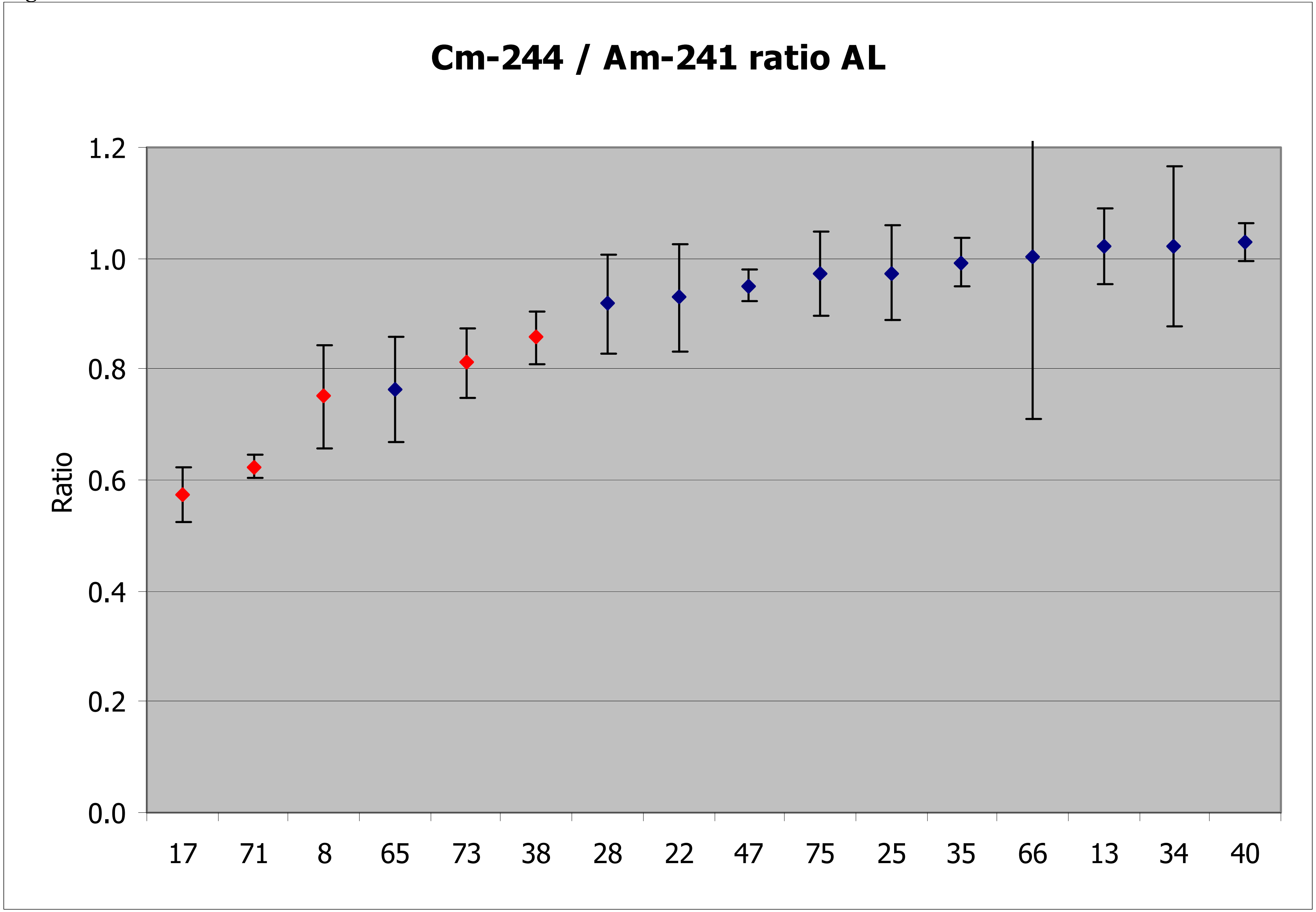
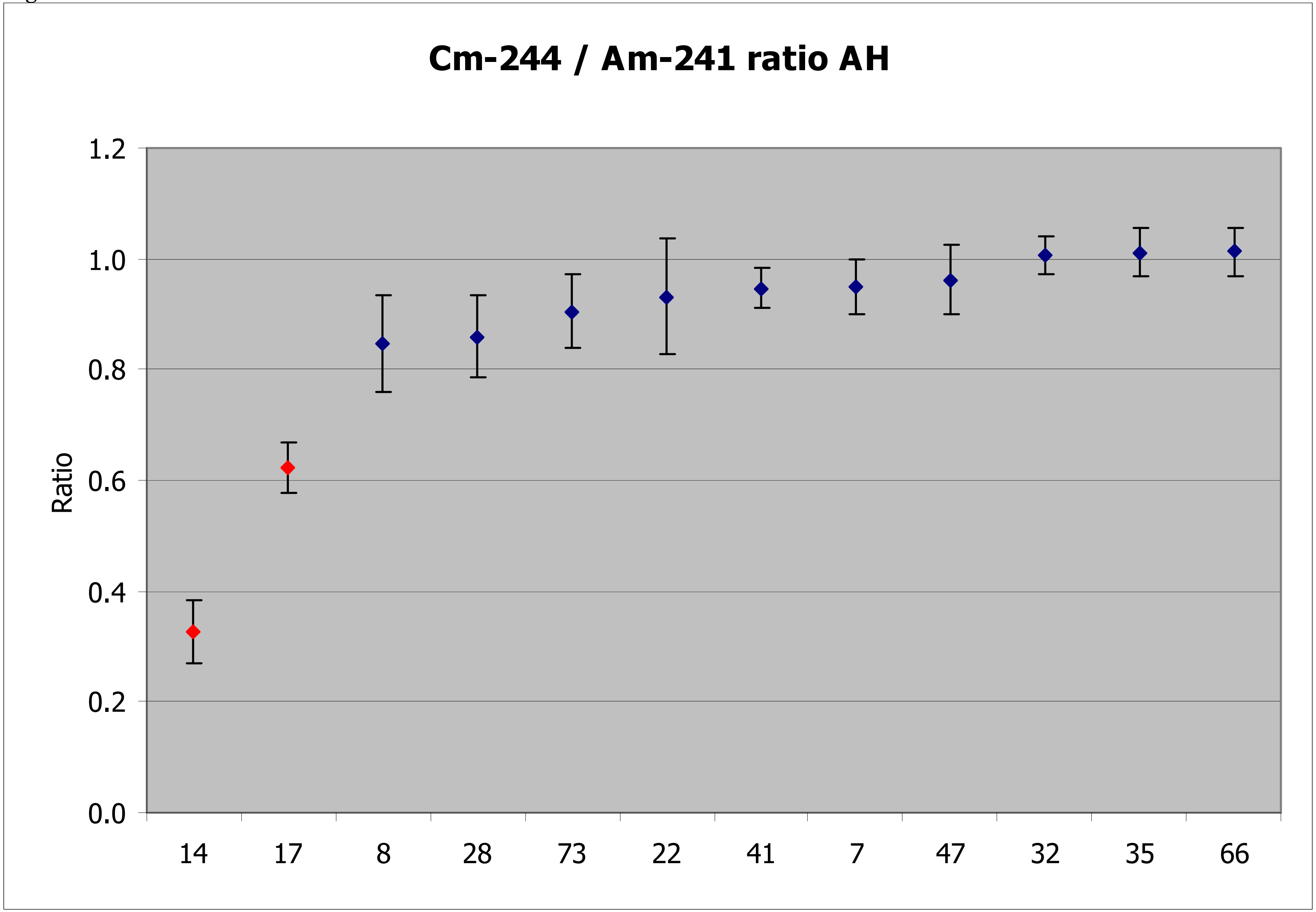


Figure 138B – Normalised ^{244}Cm / ^{241}Am ratios AH



Appendix A. Results sorted by nuclide

Table A1 – Ra-226 AL **assigned result 9.99(13) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
40G	1.59(24)	-30.64 D	-11.77 D	-84.1(24)
35P	6.9(5)	-6.02 D	-4.28 D	-31(5)
34L	9.3(11)	-0.65	-1.01	-7(11)
68	9.3(7)	-0.96	-0.96	-7(7)
47A	9.6(3)	-1.38	-0.58	-4(3)
65E	9.7(7)	-0.40	-0.40	-3(7)
73L	9.9(5)	-0.12	-0.08	-1(5)
38A	10.0(10)	0.01	0.02	0(10)
25P	10.1(6)	0.15	0.12	1(6)
8A	10(5) Q	0.05	0.30	2(45)
22L	10.3(6)	0.53	0.44	3(6)
26G	10.5(5)	1.07	0.71	5(5)
42G	11(3)	0.40	1.50	11(27)
28L	13.3(13)	2.54	4.64 Q	33(13)
66	16.1(7)	8.58 D	8.57 D	61(7)

Table A2 – Np-237 AL **assigned result 8.60(9) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
66	1.59(22)	-29.44 D	-5.60 D	-82(3)
34AM	7.2(11)	-1.27	-1.12	-16(13)
42G	11.2(19)	1.37	2.04	30(22)
38M	12.0(10)	3.38 D	2.71 D	40(12)

Table A3 – U-238 AL **assigned result 3.72(9) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
66	2.93(21)	-3.50 D	-3.39 D	-21(6)
25A	3.01(22)	-3.03 D	-3.05 D	-19(6)
17	3.09(18)	-3.18 D	-2.70 D	-17(5)
40A	3.28(9)	-3.52 Q	-1.90	-12(4)
71A	3.37(19)	-1.70	-1.51	-9(6)
47A	3.50(22)	-0.95	-0.95	-6(6)
38A	3.50(20)	-1.03	-0.95	-6(6)
13A	3.5(4)	-0.59	-0.91	-6(10)
22A	3.6(3)	-0.57	-0.74	-5(8)
73A	3.56(25)	-0.62	-0.70	-4(7)
26A	3.66(24)	-0.25	-0.27	-2(7)
75A	3.7(3)	-0.04	-0.06	0(9)
28A	3.78(10)	0.44	0.24	2(4)
65A	3.8(5)	0.15	0.29	2(12)
4A	3.8(7)	0.11	0.33	2(19)
35A	3.83(14)	0.65	0.46	3(5)
34M	3.8(3)	0.41	0.50	3(8)
8M	3.960(9)	2.79 Q	1.01	6.4(24)
29A	4.00(20)	1.28	1.18	7(6)
47M	4.019(24)	3.37 Q	1.26	8.0(25)
8A	4.07(16)	1.91	1.48	9(5)

Table A4 – Pu-238 AL **assigned result 17.13(8) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
26	12.3(5)	-10.50 D	-5.04 D	-28(3)
40	14.5(4)	-6.56 D	-2.73 D	-15.2(23)
22	16.5(12)	-0.51	-0.66	-4(7)
71	16.7(4)	-1.07	-0.46	-2.5(24)
13	16.9(9)	-0.25	-0.24	-1(6)
25	16.9(11)	-0.19	-0.20	-1(6)
73	17.0(9)	-0.14	-0.13	-1(6)
4	17.1(17)	-0.01	-0.03	0(10)
47	17.1(5)	-0.06	-0.03	0(3)
39	17.2(16)	0.05	0.08	0(9)
65	17.3(9)	0.19	0.18	1(6)
75	17.3(17)	0.10	0.18	1(10)
35	17.4(6)	0.48	0.29	2(4)
34	17.7(18)	0.32	0.60	3(11)
28	17.8(6)	1.17	0.74	4(4)
17	18.0(12)	0.72	0.90	5(7)
38	18.0(10)	0.87	0.92	5(6)
29	18.0(10)	0.87	0.92	5(6)
8	18.1(16)	0.61	1.02	6(9)
66	18.5(16)	0.86	1.45	8(9)

Table A5 – Pu-239 AL **assigned result 19.59(12) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
26	14.7(5)	-9.31 D	-4.84 D	-25(3)
40	16.3(5)	-7.35 D	-3.23 D	-16.6(22)
22	18.8(14)	-0.57	-0.79	-4(7)
71	19.1(5)	-0.96	-0.45	-2.3(24)
47	19.3(5)	-0.68	-0.34	-2(3)
13	19.3(10)	-0.29	-0.29	-1(5)
4	19.3(19)	-0.15	-0.29	-1(10)
75	19.3(11)	-0.27	-0.29	-1(6)
25	19.4(12)	-0.20	-0.23	-1(6)
39	19.6(19)	0.00	0.01	0(10)
73	19.6(10)	0.01	0.01	0(5)
65	19.6(7)	0.01	0.01	0(4)
35	19.8(7)	0.29	0.19	1(4)
28	19.9(4)	0.72	0.28	1.5(20)
38	20.0(10)	0.40	0.40	2(5)
34	20.0(20)	0.20	0.40	2(10)
29	20.0(10)	0.40	0.40	2(5)
17	20.5(13)	0.64	0.86	4(7)
66	21.1(18)	0.84	1.50	8(9)
8	21.6(19)	1.06	1.99	10(10)

Table A6 – Am-241 AL **assigned result 10.07(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
40A	8.42(19)	-8.46 D	-2.95 D	-16.4(19)
8A	8.8(7)	-1.77	-2.30	-13(7)
17	9.6(6)	-0.79	-0.85	-5(6)
25A	9.6(6)	-0.79	-0.85	-5(6)
65A	9.6(8)	-0.58	-0.83	-5(8)
38A	9.6(4)	-1.16	-0.83	-5(4)
29A	10.0(5)	-0.13	-0.12	-1(5)
34A	10.0(10)	-0.06	-0.12	-1(10)
47A	10.16(21)	0.45	0.17	0.9(21)
75A	10.2(5)	0.27	0.24	1(5)
13A	10.3(5)	0.47	0.42	2(5)
35A	10.4(4)	1.07	0.65	4(4)
22A	10.5(8)	0.55	0.78	4(8)
42G	10.6(11)	0.44	0.87	5(11)
73A	10.7(6)	1.06	1.14	6(6)
71A	10.8(3)	2.51	1.22	7(3)
28A	10.8(9)	0.86	1.31	7(9)
4A	10.9(13)	0.64	1.49	8(13)
22G	10.9(6)	1.39	1.49	8(6)
26A	11.6(5)	3.00 D	2.80 D	16(5)
66	19(4)	2.23	15.98 Q	89(40)

Table A7 – Cm-244 AL **assigned result 13.20(6) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
17	7.2(5)	-13.76 D	-7.72 D	-45(4)
8	8.6(8)	-5.75 D	-5.90 D	-35(6)
71	8.80(21)	-20.17 D	-5.69 D	-33.3(16)
65	9.6(9)	-3.99 D	-4.66 D	-27(7)
38	10.8(4)	-5.94 D	-3.11 D	-18(3)
40	11.37(25)	-7.01 Q	-2.37	-13.9(20)
73	11.4(6)	-2.99 Q	-2.33	-14(5)
25	12.2(8)	-1.28	-1.25	-7(6)
47	12.67(25)	-2.07	-0.69	-4.0(19)
22	12.8(9)	-0.43	-0.52	-3(7)
28	13.0(8)	-0.27	-0.26	-2(6)
75	13.0(8)	-0.25	-0.26	-2(6)
34	13.4(13)	0.15	0.25	1(10)
35	13.6(4)	0.91	0.47	3(3)
13	13.8(6)	0.99	0.77	5(5)
66	25(5)	2.36	15.25 Q	89(38)

Table A8 – Gross alpha AL **assigned result 93(17) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
40	16.5(13)	-4.48 D	-15.46 D	-82(4)
42	28.42(21)	-3.79 D	-13.05 D	-69(6)
56	72.8(23)	-1.17	-4.07 Q	-22(15)
65	94(5)	0.06	0.22	1(19)
25	122(10)	1.51	5.99 Q	3(3) × 10^1

Table A9 – Ra-226 AH **assigned result 4.84(7) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
21G	3.6(6) Q	-2.11	-4.19 Q	-25(12)
35P	3.84(8)	-10.03 D	-3.40 D	-20.7(19)
46P	3.95(24)	-3.59 D	-3.03 D	-18(5)
28L	4.6(10)	-0.23	-0.79	-5(21)
32A	4.61(16)	-1.34	-0.79	-5(4)
17G	4.8(4)	-0.05	-0.07	0(8)
32G	4.86(23)	0.08	0.06	0(5)
73L	4.94(20)	0.47	0.34	2(5)
47A	4.98(23)	0.56	0.46	3(5)
22L	5.3(3)	1.37	1.42	9(7)
69G	5.4(4)	1.38	1.90	12(8)
8A	5.6(23) Q	0.33	2.58 Q	16(47)
55G	5.8(6)	1.77	3.19 Q	19(11)
66	6.0(5)	2.67 D	3.94 Q	24(9)

Table A10 – Np-237 AH **assigned result 16.63(17) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
66	15.84(22)	-2.86 Q	-0.64	-4.7(16)
14A	16.7(14)	0.03	0.03	0(8)
47M	18(5)	0.18	0.70	5(29)
8M	17.6(13)	0.74	0.78	6(8)
32G	18.2(23)	0.66	1.24	9(14)
21G	18.6(11)	1.77	1.59	12(7)
55G	18.8(13)	1.69	1.75	13(8)

Table A11 – U-238 AH **assigned result 2.02(5) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
74A	1.45(5)	-8.61 D	-5.78 D	-28(3)
17	1.77(10)	-2.27	-2.53	-12(6)
47X	1.80(11)	-1.84	-2.23	-11(6)
21G	1.81(18)	-1.13	-2.12	-10(9)
22A	1.81(15)	-1.33	-2.12	-10(8)
73A	1.84(13)	-1.30	-1.82	-9(7)
28A	1.84(19)	-0.92	-1.82	-9(10)
47A	1.93(8)	-1.01	-0.93	-5(5)
47M	1.931(9)	-1.90	-0.89	-4.4(22)
32A	1.97(4)	-0.85	-0.52	-3(3)
32M	1.97(16)	-0.29	-0.50	-2(8)
35A	2.00(6)	-0.27	-0.19	-1(4)
8M	2.040(8)	0.46	0.21	1.0(23)
55M	2.088(10)	1.48	0.70	3.4(24)
8A	2.52(9)	4.78 D	5.09 D	25(6)
66	2.8(4)	2.29	7.53 Q	37(16)

Table A12 – Pu-238 AH **assigned result 16.93(5) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
14	14.5(14)	-1.69	-2.74 Q	-14(8)
73	15.4(8)	-1.90	-1.74	-9(5)
41	16.0(6)	-1.70	-1.05	-5(4)
66	16.03(21)	-4.15 Q	-1.02	-5.3(13)
35	16.1(5)	-1.71	-0.92	-5(3)
32	16.3(3)	-1.96	-0.70	-3.6(19)
22	16.6(13)	-0.25	-0.37	-2(8)
47	16.9(6)	-0.14	-0.09	0(4)
28	17.5(6)	1.02	0.70	4(4)
55A	18.0(11)	0.94	1.22	7(7)
8	18.5(16)	1.01	1.79	9(9)
55	18.9(14)	1.44	2.24	12(8)
17	19.5(10)	2.50	2.94 Q	15(6)

Table A13 – Pu-239 AH **assigned result 7.91(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
73	7.2(4)	-1.94	-1.76	-9(5)
14	7.4(9)	-0.63	-1.29	-7(11)
41	7.4(3)	-1.93	-1.19	-6(4)
66	7.45(15)	-2.96 Q	-1.10	-5.8(20)
35	7.48(23)	-1.84	-1.02	-5(3)
32	7.56(15)	-2.25	-0.83	-4.4(20)
22	7.7(7)	-0.41	-0.62	-3(8)
47	7.7(3)	-0.82	-0.57	-3(4)
28	7.97(11)	0.52	0.14	0.8(15)
55A	8.4(6)	0.88	1.12	6(7)
8	8.5(8)	0.82	1.43	8(9)
55	9.1(9)	1.27	2.72 Q	14(11)
17	9.1(5)	2.42	2.84 Q	15(6)

Table A14 – Am-241 AH **assigned result 3.858(8) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
35A	3.32(11)	-4.88 D	-3.34 D	-14(3)
47A	3.45(22)	-1.85	-2.53	-11(6)
17	3.52(19)	-1.78	-2.10	-9(5)
32A	3.61(9)	-2.61 Q	-1.53	-6.4(24)
8G	3.69(15)	-1.09	-1.04	-4(4)
41A	3.75(10)	-1.05	-0.67	-3(3)
21G	3.76(9)	-1.08	-0.61	-2.5(23)
73A	3.86(20)	0.01	0.01	0(5)
8A	3.9(3)	0.27	0.51	2(8)
32G	4.00(7)	2.06	0.85	3.6(17)
28A	4.01(19)	0.80	0.94	4(5)
55G	4.01(9)	1.63	0.94	3.9(24)
22A	4.1(4)	0.61	1.25	5(9)
22G	4.1(3)	0.85	0.80	6(7)
7A	4.10(17)	1.47	1.50	6(5)
14A	4.6(6)	1.17	4.42 Q	18(16)
66	6.04(25)	8.72 D	13.55 D	57(7)

Table A15 – Cm-244 AH **assigned result 17.23(6) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
14	6.7(8)	-13.86 D	-11.95 D	-61(5)
55	7.8(6)	-17.81 D	-10.70 D	-55(3)
17	9.8(5)	-14.23 D	-8.42 D	-43(3)
47	14.83(23)	-10.16 D	-2.72 D	-13.9(14)
8	14.9(11)	-2.20	-2.64 Q	-14(6)
35	15.0(5)	-5.27 Q	-2.52	-12.9(25)
28	15.4(11)	-1.66	-2.07	-11(7)
73	15.6(8)	-2.03	-1.84	-9(5)
41	15.9(4)	-3.57 Q	-1.55	-8.0(22)
32	16.2(4)	-2.54	-1.13	-5.8(23)
22	16.9(13)	-0.26	-0.37	-2(7)
7	17.4(6)	0.31	0.19	1(4)
66	27.3(4)	28.44 D	11.40 D	58.4(21)

Table A16 – Gross alpha AH **assigned result 75(8) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
32	72(4)	-0.33	-0.79	-4(11)
55	74.8(17)	0.03	0.06	0(11)

Table A17 – H-3 BL **assigned result 8.11(6) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
8	5.0(5)	-6.90 D	-3.16 D	-38(6)
4	6.8(20)	-0.66	-1.33	-16(25)
32	8.2(13)	0.07	0.09	1(16)
13	8.4(7)	0.42	0.30	4(9)
75	8.8(6)	1.07	0.64	8(7)
3	9.7(8)	1.98	1.58	19(10)
25	10(3)	0.55	1.65	20(37)
19	10(4)	0.47	1.91	2(5) × 10^{1}
5C	11.7(18)	2.04	3.63 Q	44(22)
35	12.6(9)	4.85 D	4.57 D	56(12)
21	12.7(17)	2.70 D	4.64 D	57(21)
5D	16.3(16)	5.02 D	8.27 D	101(20)
28	16.4(20)	4.14 D	8.38 D	102(25)
17	36(6)	4.65 D	28.19 D	34(8) × 10^{1}
40	41(5)	6.95 D	33.07 D	40(6) × 10^{1}

Table A18 – Fe-55 BL **assigned result 10.42(18) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
32	10.7(14)	0.20	0.18	3(14)
34	11.8(19)	0.72	0.91	13(18)

Table A19 – Ni-63 BL **assigned result 8.6(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
66	5.1(9)	-3.62 D	-3.54 D	-41(11)
34	7.3(9)	-1.38	-1.34	-15(11)
32	10.3(11)	1.49	1.74	20(14)
73	10.9(5)	4.22 Q	2.39	27(7)

Table A20 – Sr-89 BL **assigned result 15.90(10) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
3	8.6(25)	-2.92 D	-2.65 D	-46(16)
40	9.2(16)	-4.18 Q	-2.43	-42(10)
32	14.8(14)	-0.78	-0.40	-7(9)
66	16(5)	0.06	0.11	2(31)
22 M	19.0(20)	1.56	1.13	20(13)
22 E	22(4)	1.61	2.21	38(24)

Table A21 – Sr-90 BL **assigned result 13.37(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
22 E	10.7(18)	-1.48	-2.63 Q	-20(13)
35	10.8(12)	-2.14	-2.53	-19(9)
40	10.8(19)	-1.37	-2.53	-19(14)
76	11.5(4)	-1.59	-1.80	-14(9)
22 M	12.0(9)	-1.48	-1.34	-10(7)
25	12.6(10)	-0.81	-0.76	-6(7)
73	12.7(8)	-0.83	-0.65	-5(6)
75	12.8(6)	-0.98	-0.58	-4(5)
13	13.0(9)	-0.41	-0.37	-3(7)
3	13.2(10)	-0.19	-0.18	-1(7)
34	13.2(20)	-0.09	-0.17	-1(15)
32	13.7(10)	0.36	0.34	3(7)
8	14.90(24)	6.33 Q	1.50	11.4(18)
73E	15.4(6)	3.27 Q	2.00	15(5)
66	16.3(6)	4.87 D	2.88 D	22(5)
28	16.5(17)	1.84	3.08 Q	23(13)

Table A22 – Tc-99 BL **assigned result 16.45(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
76	4.6(5)	-25.61 D	-7.24 D	-72(3)
13	12.3(13)	-3.17 Q	-2.55	-25(8)
32	15.0(11)	-1.32	-0.89	-9(7)
8	15.2(16)	-0.77	-0.77	-8(10)
34	16.5(17)	0.03	0.03	0(10)
28	16.9(7)	0.68	0.27	3(4)
53	17.4(14)	0.68	0.58	6(9)
35	17.5(10)	1.05	0.64	6(6)
66	21.6(25)	2.06	3.15 Q	31(15)

Table A23 – Gross beta BL **assigned result 43(10) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
40	35(10)	-0.56	-2.60 Q	$-2(3) \times 10^{1}$
3	42.4(23)	-0.02	-0.08	-1(23)
56	43(3)	0.03	0.09	1(23)
25	46(4)	0.30	1.00	7(25)

Table A24 – H-3 BH **assigned result 2.720(19) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
74	2.51(6)	-3.66 Q	-1.58	-7.7(21)
21	2.57(9)	-1.63	-1.13	-6(4)
78	2.67(4)	-1.36	-0.39	-1.9(14)
5C	2.7(4)	-0.02	-0.07	0(15)
16	2.72(7)	0.00	0.00	0(3)
55	2.73(16)	0.07	0.08	0(6)
28	2.76(3)	1.25	0.30	1.5(12)
22	2.78(22)	0.27	0.45	2(8)
8	2.8(4)	0.27	0.68	3(12)
41	2.84(7)	1.73	0.91	4(3)
5D	2.8(3)	0.44	0.94	5(10)
85	2.85(0)	6.80 Q	0.98	4.8(8)
38	3.00(20)	1.40	2.11	10(8)
38C	3.1(4)	0.95	2.87 Q	14(15)
66	5.8(6)	2.67 D	3.62 D	24(9)
30	25.5(10)	22.33 D	171.8 D	84(4) × 10^{1}

Table A25 – Fe-55 BH **assigned result 5.55(10) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
21	4.4(3)	-3.64 D	-2.70 D	-21(6)
7	4.9(5)	-1.47	-1.60	-12(8)
78	4.95(9)	-4.53 Q	-1.41	-10.8(22)
74	4.99(21)	-2.38	-1.31	-10(4)
38	5.0(4)	-1.33	-1.29	-10(8)
55	6.2(5)	1.41	1.61	12(9)
30	9.0(11)	3.13 D	8.15 D	62(20)

Table A26 – Ni-63 BH **assigned result 9.8(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
66	1.88(19)	-18.15 D	-15.99 D	-80.7(21)
38	10.0(9)	0.25	0.49	2(10)
73	10.1(4)	0.67	0.77	4(6)
74	10.5(4)	1.36	1.50	8(6)
78	12.8(7)	4.07 D	6.19 D	31(8)
7	13.7(7)	4.92 D	8.00 D	40(9)

Table A27 – Sr-89 BH **assigned result 6.67(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
38	6.0(6)	-1.12	-0.91	-10(9)
55	6.9(5)	0.43	0.27	3(7)
22M	7.2(9)	0.64	0.77	9(13)
14	7.5(11)	0.72	1.08	12(17)
30	7.5(3)	2.73 Q	1.12	12(5)
78	12.1(15)	3.68 D	7.30 D	81(22)
66	15.1(12)	7.17 D	11.36 D	126(18)
22E	22(4)	4.26 D	20.20 D	224(52)

Table A28 – Sr-90 BH **assigned result 17.06(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
22E	11.8(19)	-2.77 D	-7.35 D	-31(11)
7	13.2(10)	-3.86 D	-5.39 D	-23(6)
66	13.88(19)	-16.57 D	-4.44 D	-18.7(11)
78	14.26(22)	-12.68 D	-3.91 D	-16.4(13)
14	15.0(25)	-0.84	-2.89 Q	-12(15)
22M	16.3(11)	-0.66	-1.02	-4(7)
55	16.5(5)	-1.24	-0.79	-3(3)
74	16.5(5)	-1.08	-0.75	-3(3)
38	17.40(8)	0.42	0.47	2(5)
30	17.6(4)	1.34	0.75	3.1(24)
73	17.9(7)	1.21	1.15	5(4)
28	18.0(1.1)	0.85	1.31	5(7)
8	19(6) Q	0.34	2.56	11(32)
73E	19.3(7)	3.19 D	3.12 D	13(4)
41	21.4(10)	4.25 D	6.06 D	25(6)

Table A29 – Tc-99 BH **assigned result 6.501(15) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
8	5.8(6)	-1.18	-1.61	-11(9)
74	5.91(17)	-3.42 Q	-1.32	-9(3)
46	5.93(23)	-2.48	-1.27	-9(4)
55	6.2(4)	-0.97	-0.72	-5(5)
38	6.2(5)	-0.60	-0.67	-5(8)
28	6.2(5)	-0.63	-0.60	-4(7)
66	8.9(9)	2.67 D	5.35 D	37(14)

Table A30 – Gross beta BH **assigned result 41(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
78	37.0(13)	-0.96	-1.86	-9(9)
85	45.92(0)	1.36	2.51	13(10)

Table A31 – Co-60 GL **assigned result 11.72(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	7.1(7)	-6.64 D	-7.32 D	-40(6)
29	8.7(10)	-3.02 D	-4.75 D	-26(9)
58	10.49(8)	-14.03 Q	-1.94	-10.5(8)
86	10.8(8)	-1.16	-1.40	-8(7)
84	10.89(21)	-3.91 Q	-1.31	-7.1(18)
47	10.9(8)	-1.01	-1.29	-7(7)
68	10.9(6)	-1.37	-1.29	-7(5)
17	11.0(10)	-0.80	-1.21	-7(8)
61	11.1(4)	-1.67	-0.98	-5(4)
7	11.1(7)	-0.89	-0.98	-5(6)
82	11.2(11)	-0.47	-0.82	-4(9)
19	11.2(3)	-1.73	-0.82	-4(3)
46	11.4(5)	-0.79	-0.57	-3(4)
23	11.4(8)	-0.40	-0.51	-3(7)
53	11.5(5)	-0.44	-0.35	-2(5)
65	11.5(3)	-0.71	-0.30	-1.6(23)
87	11.6(3)	-0.47	-0.22	-1(3)
81	11.6(5)	-0.24	-0.19	-1(5)
72	11.7(7)	-0.09	-0.10	-1(6)
27	11.7(13)	-0.02	-0.04	0(11)
40	11.74(24)	0.07	0.03	0.2(21)
54	11.8(6)	0.11	0.11	1(6)
73	11.8(8)	0.10	0.12	1(7)
75	11.8(23)	0.03	0.12	1(20)
76	11.8(13)	0.06	0.12	1(11)
21	11.80(20)	0.38	0.12	0.7(17)
42	11.9(12)	0.11	0.22	1(10)
62	11.9(14)	0.11	0.23	1(12)
52	11.9(5)	0.35	0.28	2(5)
35	11.9(4)	0.49	0.28	2(3)
25	12.0(6)	0.43	0.37	2(5)
39	12.1(5)	0.75	0.59	3(5)
8	12.1(10)	0.37	0.59	3(9)

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	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
34	12.1(12)	0.31	0.59	3(10)
28	12.1(9)	0.44	0.59	3(7)
41	12.2(9)	0.56	0.75	4(7)
22	12.2(5)	0.95	0.75	4(5)
38	12.3(4)	1.44	0.91	5(4)
15	12.4(7)	0.95	0.99	5(6)
66	12.40(20)	3.33 D	1.07	5.8(17)
13	12.4(6)	1.13	1.07	6(5)
4	12.5(24)	0.33	1.22	7(20)
5	12.5(13)	0.65	1.29	7(11)
30	12.6(4)	2.13	1.38	7(4)

Table A32 – Zr-95 GL **assigned result 4.21(5) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	2.4(5)	-4.07 D	-4.36 D	-43(10)
61	2.8(4)	-4.33 D	-3.39 D	-33(8)
29	2.9(3)	-4.32 D	-3.18 D	-31(7)
86	3.6(3)	-2.50	-1.60	-16(6)
84	3.58(19)	-3.22 Q	-1.53	-15(5)
19	3.9(3)	-1.03	-0.76	-7(7)
27	3.9(6)	-0.52	-0.76	-7(14)
75	3.9(4)	-0.75	-0.71	-7(9)
58	3.97(8)	-2.57	-0.59	-5.8(22)
81	4.00(20)	-1.03	-0.52	-5()
62	4.0(5)	-0.37	-0.47	-5(5)
53	4.1(3)	-0.37	-0.27	-3(12)
65	4.16(13)	-0.38	-0.13	-1(7)
76	4.2(12)	-0.05	-0.13	-1(28)
23	4.2(5)	-0.03	-0.03	0(12)
52	4.20(20)	-0.06	-0.03	0(5)
39	4.2(3)	-0.04	-0.03	0(7)
8	4.2(8)	0.01	0.02	0(18)
42	4.3(5)	0.10	0.11	1(11)
47	4.27(20)	0.27	0.14	1(5)
21	4.31(21)	0.45	0.23	2(5)
35	4.37(24)	0.64	0.38	4(6)
28	4.4(3)	0.53	0.40	4(8)
73	4.4(5)	0.37	0.45	4(12)
22	4.4(3)	0.61	0.45	4(7)
82	4.5(9)	0.29	0.60	6(20)
7	4.5(9)	0.32	0.67	7(20)
15	4.6(5)	0.77	0.84	8(11)
30	4.60(14)	2.60 Q	0.93	9(4)
41	4.6(22) Q	0.19	1.01	10(52)
38	4.70(10)	4.34 Q	1.18	12(3)
46	4.7(3)	1.81	1.20	12(7)
72	4.9(4)	1.80	1.54	15(9)

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	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
40	4.88(24)	2.72 Q	1.61	16(6)
25	5.2(5)	1.83	2.26	22(12)
5	5.2(5)	1.83	2.31	23(12)
13	5.4(6)	2.29	2.94 Q	29(13)
87	5.6(6)	2.34	3.35 Q	33(14)
34	5.8(12)	1.35	3.79 Q	37(28)
68	6.0(9)	1.94	4.32 Q	42(22)
17	6.3(13)	1.60	5.05 Q	50(31)

Table A33 – Nb-95 GL **assigned result 7.38(10) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
8	4.16(23)	-12.85 D	-6.41 D	-44(4)
65	4.93(14)	-14.25 D	-4.88 D	-33.2(21)
29	5.4(6)	-3.26 D	-3.94 D	-27(8)
27	5.6(7)	-2.52	-3.55 Q	-24(10)
58	6.34(12)	-6.67 Q	-2.07	-14.1(20)
13	6.7(11)	-0.65	-1.46	-10(15)
47	6.9(5)	-1.09	-1.02	-7(7)
52	7.0(4)	-0.93	-0.76	-5(6)
62	7.2(9)	-0.26	-0.44	-3(11)
22	7.4(4)	0.04	0.04	0(6)
21	7.6(4)	0.53	0.37	3(5)
81	7.6(4)	0.53	0.43	3(6)
53	7.6(4)	0.53	0.43	3(6)
41	7.6(25) Q	0.09	0.47	3(34)
19	8.0(3)	1.95	1.23	8(5)
30	8.3(4)	2.74 Q	1.83	12(5)
7	8.5(9)	1.19	2.25	15(13)
46	8.5(6)	1.92	2.29	16(8)
15	8.6(5)	2.34	2.46	17(7)
40	8.65(24)	4.88 Q	2.52	17(4)
84	9(5)	0.32	3.22 Q	22(68)
42	9.7(10)	2.28	4.69 Q	32(14)
73	9.8(11)	2.19	4.81 Q	33(15)
35	10.5(4)	7.39 D	6.21 D	42(6)
75	10.7(3)	10.49 D	6.60 D	45(5)
23	10.8(9)	3.77 D	6.80 D	46(12)
25	10.9(9)	3.82 D	6.96 D	47(12)
56	11.0(13)	2.78 D	7.26 D	49(18)
86	11.1(8)	4.66 D	7.38 D	50(11)
5	11.4(11)	3.51 D	8.00 D	54(16)
82	12(4)	1.25	8.20 Q	56(45)
72	12.3(8)	6.13 D	9.83 D	67(11)
17	14(3)	2.26	12.89 Q	88(39)

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	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
76	14.1(20)	3.32 D	13.29 D	90(27)
28	14.6(11)	6.54 D	14.37 D	98(15)
34	15(4)	2.28	14.96 Q	102(45)
39	16.6(10)	9.17 D	18.35 D	125(14)
87	23.1(12)	12.84 D	31.28 D	213(17)

Table A34 – Sb-125 GL **assigned result 13.45(7) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	9.7(7)	-5.14 D	-4.54	-28(6)
29	10.2(8)	-4.05 D	-3.92	-24(6)
66	10.9(3)	-8.32 D	-3.08	-19.0(23)
27	11.2(16)	-1.45	-2.72 Q	-17(12)
61	11.8(6)	-2.84 Q	-1.99	-12(5)
58	12.07(18)	-7.24 Q	-1.67	-10.3(14)
84	12.5(4)	-2.36	-1.15	-7(3)
19	12.6(5)	-1.69	-1.03	-6(4)
53	12.7(7)	-1.07	-0.91	-6(5)
86	12.8(9)	-0.75	-0.83	-5(7)
25	12.8(7)	-0.90	-0.78	-5(6)
28	12.8(9)	-0.69	-0.75	-5(7)
47	12.9(5)	-1.20	-0.64	-4(4)
5	13.0(13)	-0.36	-0.56	-3(10)
81	13.0(6)	-0.75	-0.55	-3(5)
65	13.1(5)	-0.88	-0.46	-3(4)
41	13.1(14)	-0.25	-0.43	-3(11)
82	13.1(15)	-0.24	-0.43	-3(11)
39	13.1(7)	-0.50	-0.43	-3(5)
87	13.2(8)	-0.26	-0.26	-2(6)
42	13.4(14)	-0.06	-0.10	-1(10)
38	13.4(5)	-0.11	-0.07	0(4)
68	13.4(12)	-0.03	-0.04	0(9)
46	13.5(6)	-0.01	-0.01	0(4)
52	13.5(8)	0.06	0.05	0(6)
62	13.6(16)	0.07	0.13	1(12)
54	13.6(9)	0.13	0.14	1(7)
35	13.6(5)	0.33	0.18	1(4)
8	13.6(17)	0.09	0.18	1(12)
23	13.6(9)	0.16	0.18	1(7)
76	13.7(12)	0.16	0.24	1(9)
75	13.8(7)	0.50	0.42	3(5)
21	13.9(4)	1.10	0.54	3(3)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
30	13.9(4)	1.19	0.54	3(3)
73	14.0(15)	0.36	0.66	4(11)
72	14.0(9)	0.66	0.71	4(7)
17	14.5(15)	0.73	1.28	8(11)
13	14.6(9)	1.27	1.38	9(7)
22	14.6(7)	1.63	1.38	9(5)
7	14.8(13)	1.03	1.62	10(10)
40	14.88(24)	5.73 Q	1.72	10.6(19)
15	15.0(9)	1.67	1.84	11(7)
34	16(4)	0.86	3.43 Q	21(25)

Table A35 – Ba-133 GL **assigned result 4.15(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	1.5(3)	-10.30 D	-9.84 D	-65(6)
29	3.1(3)	-3.50 D	-3.85 D	-25(7)
66	3.14(12)	-8.23 D	-3.71 D	-24(3)
58	3.46(7)	-9.19 Q	-2.54	-16.7(18)
86	3.6(3)	-2.23	-2.14	-14(6)
62	3.6(5)	-1.31	-2.06	-14(10)
75	3.60(13)	-4.17 Q	-2.03	-13(4)
81	3.60(20)	-2.75 Q	-2.03	-13(5)
35	3.62(15)	-3.50 Q	-1.95	-13(4)
5	3.7(4)	-1.28	-1.73	-11(9)
27	3.7(5)	-0.91	-1.66	-11(12)
40	3.71(24)	-1.84	-1.62	-11(6)
28	3.7(3)	-1.58	-1.51	-10(6)
42	3.8(4)	-1.03	-1.48	-10(9)
34	3.8(8)	-0.53	-1.44	-9(18)
53	3.80(15)	-2.32	-1.30	-9(4)
25	3.84(25)	-1.25	-1.15	-8(6)
7	3.9(4)	-0.79	-1.11	-7(9)
84	3.86(10)	-2.83 Q	-1.08	-7.1(25)
72	3.88(25)	-1.09	-1.00	-7(6)
76	3.9(7)	-0.40	-1.00	-7(17)
8	3.9(5)	-0.51	-0.97	-6(13)
19	3.90(20)	-1.26	-0.93	-6(5)
23	4.0(4)	-0.39	-0.56	-4(10)
47	4.01(15)	-0.95	-0.53	-3(4)
65	4.01(12)	-1.17	-0.53	-3(3)
87	4.04(20)	-0.57	-0.42	-3(5)
30	4.10(22)	-0.25	-0.20	-1(6)
39	4.10(20)	-0.27	-0.20	-1(5)
21	4.17(17)	0.09	0.06	0(4)
52	4.20(20)	0.23	0.17	1(5)
22	4.20(20)	0.23	0.17	1(5)
73	4.2(4)	0.11	0.17	1(10)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
46	4.22(19)	0.34	0.24	2(5)
13	4.3(4)	0.26	0.35	2(9)
68	4.3(4)	0.37	0.53	4(9)
38	4.5(3)	1.15	1.26	8(7)
82	4.5(5)	0.68	1.30	9(13)
15	4.6(3)	1.39	1.48	10(7)
41	4.6(10)	0.46	1.66	11(24)
54	4.8(5)	1.42	2.29	15(11)
17	6.6(12)	2.13	8.93 Q	59(28)

Table A36 – Cs-134 GL **assigned result 3.95(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	2.39(23)	-6.74 D	-5.69 D	-40(6)
61	2.77(17)	-6.85 D	-4.30 D	-30(5)
29	2.9(3)	-3.49 D	-3.83 D	-27(8)
27	2.9(5)	-2.10	-3.83 Q	-27(13)
86	3.23(23)	-3.11 D	-2.63 D	-18(6)
17	3.3(5)	-1.30	-2.37	-16(13)
62	3.3(4)	-1.64	-2.34	-16(10)
58	3.44(7)	-6.77 Q	-1.86	-12.9(19)
5	3.5(4)	-1.37	-1.75	-12(9)
25	3.5(3)	-1.62	-1.72	-12(8)
19	3.50(20)	-2.23	-1.64	-11(5)
41	3.6(6)	-0.59	-1.35	-9(16)
28	3.60(25)	-1.40	-1.28	-9(7)
72	3.65(23)	-1.30	-1.10	-8(6)
8	3.7(5)	-0.64	-1.10	-8(12)
84	3.66(9)	-3.09 Q	-1.06	-7.4(24)
75	3.69(15)	-1.71	-0.95	-7(4)
81	3.7(2)	-1.24	-0.92	-6(5)
47	3.72(13)	-1.74	-0.84	-6(4)
35	3.73(18)	-1.21	-0.81	-6(5)
42	3.8(4)	-0.38	-0.55	-4(10)
39	3.80(20)	-0.75	-0.55	-4(5)
40	3.84(24)	-0.46	-0.40	-3(6)
66	3.90(15)	-0.33	-0.19	-1(4)
53	3.9(3)	-0.19	-0.19	-1(7)
73	3.9(4)	-0.13	-0.19	-1(10)
34	3.9(4)	-0.11	-0.15	-1(10)
76	3.9(6)	-0.05	-0.11	-1(15)
21	3.92(11)	-0.27	-0.11	-1(3)
68	3.9(4)	-0.03	-0.04	0(8)
65	3.95(7)	-0.01	0.00	0.0(19)
52	4.00(20)	0.24	0.18	1(5)
46	4.04(17)	0.52	0.32	2(5)

continues

continued

	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
54	4.0(3)	0.30	0.32	2(8)
13	4.1(3)	0.37	0.40	3(8)
87	4.18(24)	0.95	0.83	6(6)
23	4.2(5)	0.50	0.91	6(13)
30	4.20(16)	1.53	0.91	6(4)
38	4.3(3)	1.16	1.27	9(8)
22	4.40(20)	2.22	1.64	11(5)
82	4.5(5)	1.23	2.11	15(12)
15	4.6(3)	2.09	2.22	15(8)
7	4.8(7)	1.14	2.91 Q	20(18)

Table A37 – Cs-137 GL **assigned result 8.84(6) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	6.4(8)	-3.26 D	-4.69 D	-28(9)
29	6.5(5)	-4.64 D	-4.41 D	-26(6)
58	7.85(9)	-9.03 Q	-1.86	-11.2(12)
84	8.36(23)	-2.01	-0.90	-5(3)
27	8.5(10)	-0.34	-0.64	-4(11)
66	8.50(15)	-2.08	-0.64	-3.8(18)
5	8.6(9)	-0.32	-0.52	-3(10)
86	8.7(6)	-0.29	-0.34	-2(7)
19	8.7(3)	-0.45	-0.26	-2(4)
75	8.74(17)	-0.54	-0.18	-1.1(20)
25	8.8(4)	-0.14	-0.11	-1(5)
81	8.8(4)	-0.09	-0.07	0(5)
21	8.80(19)	-0.19	-0.07	-0.4(23)
52	8.8(5)	-0.08	-0.07	0(6)
82	8.8(9)	-0.02	-0.03	0(11)
40	8.86(24)	0.09	0.04	0(3)
47	8.9(3)	0.07	0.04	0(4)
7	8.9(7)	0.05	0.06	0(8)
87	8.87(22)	0.14	0.06	0(3)
35	8.9(3)	0.20	0.12	1(4)
54	8.9(8)	0.08	0.12	1(9)
23	8.9(8)	0.08	0.12	1(9)
53	8.9(4)	0.15	0.12	1(5)
39	8.9(6)	0.10	0.12	1(7)
61	9.0(4)	0.26	0.21	1(5)
65	8.96(25)	0.47	0.23	1(3)
62	9.0(10)	0.12	0.23	1(12)
73	9.0(6)	0.27	0.31	2(7)
68	9.0(6)	0.29	0.34	2(7)
28	9.1(7)	0.38	0.46	3(7)
8	9.1(9)	0.28	0.46	3(10)
22	9.1(4)	0.65	0.49	3(5)
46	9.2(4)	0.90	0.59	4(4)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
72	9.2(6)	0.58	0.66	4(7)
13	9.2(6)	0.73	0.74	4(6)
42	9.2(10)	0.42	0.76	5(11)
34	9.3(9)	0.54	0.95	6(11)
76	9.4(11)	0.50	1.04	6(13)
38	9.4(4)	1.39	1.06	6(5)
15	9.5(5)	1.36	1.19	7(6)
30	9.5(3)	2.31	1.25	7(4)
83	9.6(6)	1.26	1.44	9(7)
4	9.7(20)	0.43	1.63	10(23)
17	9.8(7)	1.36	1.76	11(8)
41	10(8) Q	0.16	2.48	15(95)

Table A38 – Ce-144 GL **assigned result 14.80(10) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	9.0(21)	-2.73 D	-5.48	-39(14)
29	10.7(10)	-4.08 D	-3.88	-28(7)
58	13.2(4)	-3.88 Q	-1.55	-11(3)
84	13.3(4)	-3.63 Q	-1.42	-10(3)
19	13.7(7)	-1.56	-1.04	-7(5)
39	13.8(12)	-0.83	-0.95	-7(8)
53	13.9(9)	-1.05	-0.90	-6(6)
42	14.2(16)	-0.41	-0.60	-4(10)
23	14.3(9)	-0.55	-0.47	-3(6)
72	14.4(11)	-0.41	-0.43	-3(8)
22	14.5(10)	-0.30	-0.28	-2(7)
5	14.5(15)	-0.20	-0.27	-2(10)
52	14.6(9)	-0.22	-0.19	-1(6)
38	14.6(7)	-0.28	-0.19	-1(5)
17	15(3)	-0.01	-0.03	0(20)
47	14.8(6)	-0.03	-0.02	0(5)
61	14.8(17)	0.00	0.00	0(11)
86	14.8(11)	0.00	0.00	0(8)
68	14.8(22)	0.02	0.04	0(15)
25	14.9(10)	0.07	0.07	0(7)
28	14.9(10)	0.10	0.09	1(7)
82	15.0(22)	0.09	0.19	1(15)
73	15.0(17)	0.12	0.19	1(12)
65	15.0(5)	0.48	0.22	2(4)
81	15.1(7)	0.42	0.28	2(5)
21	15.1(6)	0.49	0.28	2(4)
46	15.1(7)	0.47	0.31	2(5)
54	15.3(24)	0.22	0.51	4(17)
13	15.4(11)	0.54	0.57	4(8)
75	15.4(5)	1.17	0.57	4(4)
27	15.5(25)	0.29	0.66	5(17)
35	15.7(7)	1.27	0.85	6(5)
34	16(3)	0.29	0.85	6(21)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
8	16(3)	0.34	0.85	6(18)
40	15.86(24)	4.05 Q	1.00	7.2(18)
7	16.0(16)	0.77	1.13	8(10)
15	16.4(13)	1.18	1.48	11(9)
62	16.4(21)	0.78	1.52	11(14)
30	16.6(9)	1.96	1.70	12(6)
87	17.1(11)	2.11	2.15	15(7)
41	18(4)	0.82	3.04 Q	22(26)

Table A39 – Eu-152 GL **assigned result 17.91(12) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	11.5(8)	-8.44 D	-6.44 D	-36(5)
27	12.6(5)	-10.32 D	-5.34 D	-30(3)
29	12.6(10)	-5.28 D	-5.34 D	-30(6)
25	12.8(10)	-5.17 D	-5.18 D	-29(6)
41	13(5)	-0.98	-4.46 Q	-25(25)
17	13.8(13)	-3.12 D	-4.18 D	-23(8)
61	15.0(5)	-5.66 D	-2.93 D	-16(3)
40	15.24(24)	-9.92 D	-2.69 D	-14.9(15)
34	15(3)	-0.81	-2.53	-14(17)
23	15.4(10)	-2.50	-2.53	-14(6)
68	15.5(10)	-2.34	-2.40	-13(6)
62	15.7(18)	-1.24	-2.22	-12(10)
19	15.8(5)	-4.11 Q	-2.12	-12(3)
84	15.9(6)	-3.29 Q	-2.02	-11(4)
72	16.0(10)	-1.95	-1.97	-11(6)
86	16.0(12)	-1.67	-1.94	-11(7)
58	16.01(17)	-9.08 Q	-1.91	-10.6(11)
28	16.1(12)	-1.50	-1.82	-10(7)
35	16.3(5)	-3.39 Q	-1.62	-9(3)
81	16.7(7)	-1.71	-1.22	-7(4)
53	16.7(8)	-1.50	-1.22	-7(5)
52	16.9(9)	-1.12	-1.02	-6(5)
42	17.0(17)	-0.53	-0.93	-5(10)
47	17.1(6)	-1.44	-0.83	-5(10)
66	17.2(8)	-0.88	-0.72	-4(5)
65	17.3(4)	-1.49	-0.63	-3.5(23)
75	17.3(9)	-0.68	-0.62	-3(5)
5	17.4(17)	-0.27	-0.48	-3(10)
87	17.5(7)	-0.68	-0.45	-2(4)
76	17.5(12)	-0.36	-0.42	-2(7)
39	17.7(9)	-0.24	-0.22	-1(5)
21	17.7(5)	-0.42	-0.22	-1(3)
22	17.8()	-0.19	-0.12	-1(4)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
46	18.0(6)	0.11	0.09	0(5)
54	18.0(9)	0.12	0.11	1(5)
8	18.1(20)	0.09	0.19	1(11)
73	18.5(21)	0.28	0.59	3(12)
82	18.7(20)	0.39	0.79	4(11)
30	19.0(11)	0.98	1.09	6(6)
13	19.2(13)	0.98	1.29	7(7)
15	19.7(12)	1.55	1.80	10(7)
7	20.0(17)	1.26	2.09	12(9)
38	20.6(6)	4.38 D	2.70 D	15(4)

Table A40 – Eu-155 GL **assigned result 6.18(5) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
56	3.1(4)	-7.42 D	-6.24 D	-50(7)
66	3.6(4)	-7.43 D	-5.20 D	-41(6)
61	4.3(8)	-2.30	-3.85 Q	-31(13)
29	4.7(4)	-3.68 D	-3.02 D	-24(7)
72	5.0(4)	-3.13 Q	-2.51	-20(7)
58	5.1(3)	-4.24 Q	-2.28	-18(5)
53	5.5(4)	-1.69	-1.39	-11(7)
52	5.6(3)	-1.91	-1.18	-9(5)
82	5.6(9)	-0.63	-1.14	-9(14)
68	5.6(6)	-0.96	-1.10	-9(9)
84	5.8(3)	-1.25	-0.78	-6(5)
5	6.0(6)	-0.32	-0.39	-3(10)
65	6.02(22)	-0.71	-0.33	-3(4)
25	6.0(4)	-0.41	-0.33	-3(7)
8	6.0(11)	-0.13	-0.29	-2(18)
40	6.07(24)	-0.45	-0.23	-2(4)
19	6.1(5)	-0.16	-0.16	-1(8)
76	6.1(11)	-0.08	-0.16	-1(17)
35	6.11(22)	-0.31	-0.14	-1(4)
42	6.2(8)	0.06	0.10	1(13)
23	6.3(5)	0.24	0.24	2(8)
47	6.3(3)	0.55	0.30	2(5)
86	6.4(6)	0.37	0.43	3(9)
73	6.4(7)	0.31	0.45	4(11)
21	6.5(5)	0.62	0.57	5(7)
75	6.50(23)	1.36	0.65	5(4)
54	6.5(8)	0.40	0.69	5(14)
28	6.6(5)	0.84	0.79	6(8)
22	6.6(6)	0.70	0.86	7(10)
81	6.7(3)	1.71	1.06	8(5)
46	6.7(3)	1.83	1.06	8(5)
30	6.7(4)	1.47	1.06	8(6)
87	6.7(5)	1.17	1.10	9(8)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
13	6.7(5)	1.07	1.12	9(8)
39	6.8(4)	1.54	1.26	10(7)
15	6.9(6)	1.27	1.41	11(9)
34	6.9(14)	0.50	1.41	11(22)
62	6.9(8)	0.87	1.41	11(13)
38	6.9(5)	1.43	1.47	12(8)
17	7.1(13)	0.69	1.87	15(22)
41	7.3(14)	0.84	2.34	19(22)
7	7.4(10)	1.23	2.51	20(16)
27	8.8(15)	1.81	5.34 Q	42(23)

Table A41 – Co-60 GH **assigned result 16.32(5) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
48	13.7(5)	-5.59 D	-3.94 D	-16(3)
68	14.9(6)	-2.35	-2.16	-9(4)
74	15.1(6)	-2.05	-1.85	-7(4)
87	15.49(18)	-4.42 Q	-1.26	-5.1(11)
54	15.5(7)	-1.25	-1.26	-5(4)
61	15.5(3)	-2.69 Q	-1.25	-5.0(19)
35	15.6(4)	-1.74	-1.09	-4.4(25)
45	15.8(6)	-0.92	-0.77	-3(4)
25	15.8(7)	-0.72	-0.73	-3(4)
53	15.9(7)	-0.65	-0.64	-3(4)
7	16.0(9)	-0.37	-0.48	-2(5)
82	16.0(16)	-0.20	-0.48	-2(10)
47	16.0(5)	-0.64	-0.45	-2(3)
8	16.1(7)	-0.33	-0.33	-1(4)
59	16.2(9)	-0.14	-0.19	-1(6)
55	16.20(17)	-0.66	-0.18	-0.7(11)
52	16.2(7)	-0.17	-0.18	-1(5)
73	16.3(8)	-0.02	-0.03	0(5)
21	16.3(3)	-0.06	-0.03	-0.1(19)
27	16.3(17)	-0.01	-0.03	0(10)
9	16.3(10)	-0.01	-0.02	0(6)
14	16.4(6)	0.07	0.06	0(4)
86	16.4(12)	0.04	0.08	0(7)
4	16(4) Q	0.02	0.12	1(21)
32	16.4(3)	0.44	0.19	0.7(17)
26	16.5(9)	0.15	0.20	1(6)
18	16.5(5)	0.36	0.28	1(3)
79	16.5(3)	0.58	0.28	1.1(19)
77	16.6(10)	0.28	0.43	2(6)
16	16.6(4)	0.87	0.43	1.7(20)
67	16.6(10)	0.30	0.44	2(6)
46	16.6(6)	0.53	0.46	2(4)
28	16.7(12)	0.32	0.58	2(8)
13	16.9(8)	0.73	0.89	4(5)

continues

continued				
	Result (Bq kg^{-1})	Zeta score	z-score	Deviation (%)
5	16.9(17)	0.36	0.92	4(10)
85	17.2(5)	1.65	1.31	5(4)
80	17.2(3)	2.93 Q	1.36	5.5(19)
15	17.5(9)	1.31	1.80	7(6)

Table A42 – Zr-95 GH **assigned result 6.82(8) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
61	5.11(5)	-18.02 D	-6.32 D	-25.0(11)
27	5.4(6)	-2.55	-5.24 Q	-21(8)
48	6.26(21)	-2.48	-2.06	-8(4)
59	6.5(4)	-0.94	-1.32	-5(6)
79	6.47(15)	-2.04	-1.28	-5.1(25)
47	6.53(10)	-2.26	-1.05	-4.2(18)
53	6.6(4)	-0.79	-0.99	-4(5)
55	6.57(14)	-1.53	-0.91	-3.6(23)
77	6.6(5)	-0.51	-0.80	-3(6)
21	6.76(14)	-0.35	-0.21	-0.8(24)
8	6.8(4)	-0.17	-0.21	-1(5)
35	6.79(18)	-0.14	-0.10	0(3)
32	6.79(15)	-0.16	-0.10	-0.4(25)
73	6.8(3)	-0.05	-0.06	0(5)
68	6.810(20)	-0.08	-0.03	-0.1(12)
26	6.8(3)	-0.02	-0.03	0(4)
82	6.8(7)	-0.01	-0.03	0(10)
7	6.9(4)	0.14	0.20	1(6)
46	6.87(24)	0.21	0.20	1(4)
52	6.9(4)	0.20	0.31	1(6)
14	6.92(25)	0.39	0.38	2(4)
18	6.93(23)	0.46	0.42	2(4)
45	6.95(25)	0.51	0.49	2(4)
25	7.0(3)	0.48	0.57	2(5)
28	7.0(5)	0.37	0.68	3(7)
67	7.0(6)	0.41	0.83	3(8)
9	7.1(5)	0.55	1.06	4(8)
16	7.12(22)	1.29	1.12	4(4)
5	7.2(7)	0.46	1.23	5(11)
80	7.23(12)	2.86 Q	1.53	6.1(22)
13	7.3(4)	1.28	1.94	8(6)
15	7.5(3)	2.13	2.45	10(5)
85	8.0(3)	3.78 D	4.34 D	17(5)
87	8.00(24)	4.67 D	4.38 D	17(4)
86	9.1(7)	3.46 D	8.37 D	33(10)

Table A43 – Nb-95 GH **assigned result 11.94(16) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
86	6.2(5)	-12.35 D	-9.08 D	-48(4)
67	6.9(5)	-10.01 D	-7.95 D	-42(4)
9	6.9(5)	-9.51 D	-7.85 D	-42(5)
27	10.2(11)	-1.67	-2.78 Q	-15(9)
8	10.2(5)	-3.32 D	-2.74 D	-15(5)
48	10.9(4)	-2.56	-1.62	-9(4)
59	11.3(7)	-0.86	-0.94	-5(6)
53	11.5(6)	-0.74	-0.70	-4(5)
79	11.73(22)	-0.78	-0.33	-1.8(23)
32	11.8(8)	-0.19	-0.23	-1(7)
47	11.8(3)	-0.39	-0.21	-1(3)
45	11.9(7)	-0.09	-0.10	-1(6)
21	12.00(20)	0.22	0.09	0.5(21)
26	12.0(11)	0.05	0.09	0(9)
52	12.0(6)	0.09	0.09	0(5)
18	12.1(6)	0.25	0.25	1(5)
55	12.1(3)	0.49	0.25	1(3)
46	12.4(8)	0.61	0.76	4(7)
13	12.5(12)	0.46	0.87	5(10)
77	12.6(9)	0.76	1.03	5(7)
25	12.7(10)	0.78	1.20	6(8)
80	12.9(3)	2.95 Q	1.45	8(3)
82	13(4) Q	0.27	1.50	8(29)
7	13.0(7)	1.44	1.64	9(6)
14	13.2(5)	2.58 Q	1.89	10(4)
15	14.3(6)	3.80 D	3.70 D	20(6)
16	14.3(4)	6.43 D	3.70 D	20(4)
73	15.0(8)	3.75 D	4.80 D	26(7)
35	15.6(4)	8.31 D	5.74 D	31(4)
5	15.8(16)	2.41	6.01 Q	32(13)
28	20.6(15)	5.74 D	13.59 D	72(13)
87	36.1(7)	34.57 D	37.91 D	202(7)

Table A44 – Sb-125 GH **assigned result 17.24(8) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
35	15.5(4)	-4.27 Q	-2.36	-10.1(24)
59	16.1(9)	-1.28	-1.61	-7(6)
48	16.1(6)	-2.09	-1.55	-7(4)
27	16.2(17)	-0.61	-1.42	-6(10)
53	16.2(7)	-1.48	-1.42	-6(4)
77	16.2(10)	-1.05	-1.42	-6(6)
7	16.4(9)	-0.93	-1.14	-5(5)
25	16.5(7)	-1.14	-1.08	-5(4)
47	16.56(21)	-3.03 Q	-0.93	-4.0(13)
55	16.7(4)	-1.43	-0.74	-3.2(22)
45	16.7(8)	-0.60	-0.68	-3(5)
79	16.9(4)	-0.88	-0.47	-2.0(23)
32	16.9(4)	-0.89	-0.41	-1.8(20)
54	17.0(5)	-0.56	-0.40	-2(3)
68	17.0(7)	-0.41	-0.38	-2(4)
28	17.0(12)	-0.20	-0.33	-1(7)
52	17.0(9)	-0.27	-0.33	-1(5)
21	17.1(3)	-0.46	-0.19	-0.8(18)
26	17.1(5)	-0.25	-0.15	-1(3)
14	17.1(8)	-0.13	-0.14	-1(5)
46	17.2(6)	-0.07	-0.06	0(4)
61	17.20(12)	-0.30	-0.06	-0.3(9)
16	17.2(6)	-0.07	-0.06	0(4)
87	17.2(5)	-0.07	-0.05	0(3)
8	17.4(10)	0.16	0.21	1(6)
73	17.5(8)	0.32	0.35	1(5)
18	17.5(6)	0.42	0.35	1(4)
82	17.5(18)	0.14	0.35	1(10)
5	17.5(18)	0.16	0.39	2(10)
86	17.5(12)	0.24	0.40	2(7)
9	17.6(10)	0.40	0.54	2(6)
67	17.7(12)	0.42	0.67	3(7)
80	18.0(6)	1.21	1.01	4(4)
13	18.0(11)	0.69	1.03	4(7)
15	18.9(8)	2.06	2.25	10(5)
85	20.5(10)	3.28 D	4.42 D	19(6)

Table A45 – Ba-133 GH **assigned result 4.07(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
35	3.35(9)	-7.61 D	-3.96 D	-17.6(23)
27	3.5(4)	-1.61	-3.13 Q	-14(9)
77	3.53(21)	-2.53	-2.96 Q	-13(5)
7	3.55(20)	-2.62 D	-2.85 D	-13(5)
45	3.59(23)	-2.06	-2.63 Q	-12(6)
25	3.67(16)	-2.44	-2.19	-10(4)
53	3.75(16)	-1.95	-1.75	-8(4)
28	3.8(3)	-1.17	-1.75	-8(7)
52	3.80(20)	-1.32	-1.47	-7(5)
59	3.83(22)	-1.07	-1.31	-6(6)
55	3.83(11)	-2.09	-1.31	-6(3)
8	3.84(21)	-1.07	-1.25	-6(5)
9	3.9(3)	-0.76	-1.10	-5(7)
67	3.9(3)	-0.68	-1.09	-5(7)
86	3.9(3)	-0.66	-1.03	-5(7)
79	3.89(11)	-1.56	-0.98	-4(3)
16	3.89(24)	-0.73	-0.98	-4(6)
68	3.90(15)	-1.09	-0.92	-4(4)
48	3.92(13)	-1.11	-0.81	-4(4)
47	3.96(5)	-1.86	-0.61	-2.7(14)
5	4.0(4)	-0.27	-0.59	-3(10)
82	4.0(5)	-0.23	-0.54	-2(11)
21	3.98(8)	-1.03	-0.48	-2.1(21)
13	4.01(25)	-0.23	-0.31	-1(6)
18	4.02(13)	-0.35	-0.26	-1(4)
46	4.03(14)	-0.26	-0.20	-1(4)
14	4.03(18)	-0.20	-0.20	-1(5)
87	4.05(18)	-0.09	-0.09	0(5)
32	4.05(8)	-0.16	-0.07	-0.3(19)
61	4.07(5)	0.05	0.02	0.1(14)
54	4.08(18)	0.07	0.07	0(5)
73	4.20(20)	0.66	0.73	3(5)
80	4.22(7)	2.03	0.84	3.8(19)
26	4.22(17)	0.89	0.84	4(5)
15	4.48(18)	2.27	2.28	10(5)
85	4.7(4)	1.77	3.44 Q	15(9)

Table A46 – Cs-134 GH **assigned result 1.127(8) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	z-score	Deviation (%)
74	0.94(4)	-4.93 D	-3.75 D	-17(4)
87	0.97(4)	-3.85 D	-3.15 D	-14(4)
27	1.00(10)	-1.27	-2.55	-11(9)
25	1.00(9)	-1.41	-2.55	-11(8)
79	1.00(12)	-1.06	-2.55	-11(11)
35	1.01(3)	-3.77 Q	-2.35	-10(3)
7	1.02(6)	-1.93	-2.15	-10(5)
48	1.02(4)	-2.63 Q	-2.15	-10(4)
68	1.02(4)	-2.63 Q	-2.15	-10(4)
53	1.03(5)	-1.92	-1.95	-9(5)
9	1.03(8)	-1.24	-1.95	-9(7)
86	1.03(7)	-1.38	-1.95	-9(6)
61	1.050(10)	-6.00 Q	-1.55	-6.9(11)
5	1.05(11)	-0.70	-1.55	-7(10)
77	1.06(6)	-1.11	-1.35	-6(6)
59	1.06(6)	-1.11	-1.35	-6(6)
16	1.06(3)	-2.16	-1.35	-6(3)
28	1.06(8)	-0.89	-1.35	-6(7)
47	1.062(14)	-4.03 Q	-1.31	-5.8(14)
67	1.09(13)	-0.29	-0.75	-3(12)
54	1.09(4)	-0.91	-0.75	-3(4)
32	1.10(4)	-0.83	-0.57	-3(3)
52	1.10(5)	-0.54	-0.55	-2(5)
21	1.110(20)	-0.80	-0.35	-1.5(19)
46	1.12(4)	-0.18	-0.15	-1(4)
26	1.12(4)	-0.18	-0.15	-1(4)
14	1.13(5)	0.05	0.05	0(5)
55	1.13(4)	0.07	0.05	0(4)
8	1.14(6)	0.21	0.26	1(6)
73	1.14(6)	0.21	0.26	1(6)
18	1.15(4)	0.56	0.46	2(4)
13	1.16(6)	0.54	0.66	3(6)
45	1.17(10)	0.43	0.86	4(9)
80	1.17(3)	1.38	0.86	4(3)
85	1.19(5)	1.24	1.26	6(5)
82	1.20(12)	0.60	1.46	6(11)
15	1.25(5)	2.42	2.46	11(5)

Table A47 – Cs-137 GH **assigned result 3.68(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
82	3.3(4)	-1.02	-2.36	-9(9)
48	3.37(11)	-2.70 Q	-2.15	-8(3)
87	3.43(6)	-3.73 Q	-1.73	-6.7(18)
59	3.48(20)	-0.98	-1.38	-5(6)
79	3.48(7)	-2.61 Q	-1.38	-5.4(20)
53	3.53(13)	-1.11	-1.03	-4(4)
74	3.59(14)	-0.61	-0.61	-2(4)
47	3.61(6)	-1.10	-0.49	-1.9(17)
35	3.61(10)	-0.65	-0.47	-2(3)
7	3.61(20)	-0.34	-0.47	-2(6)
25	3.62(15)	-0.37	-0.40	-2(4)
68	3.65(14)	-0.19	-0.19	-1(4)
8	3.65(17)	-0.16	-0.19	-1(5)
54	3.66(25)	-0.07	-0.12	0(7)
77	3.68(22)	0.01	0.02	0(6)
73	3.70(20)	0.11	0.16	1(6)
52	3.70(20)	0.11	0.16	1(6)
32	3.71(7)	0.45	0.23	0.9(20)
21	3.72(11)	0.38	0.30	1(3)
46	3.72(13)	0.32	0.30	1(4)
45	3.72(13)	0.32	0.30	1(4)
26	3.76(14)	0.58	0.58	2(4)
18	3.78(12)	0.84	0.72	3(4)
61	3.78(6)	1.56	0.72	2.8(18)
28	3.8(3)	0.45	0.86	3(8)
16	3.82(9)	1.52	1.00	4(3)
14	3.83(13)	1.15	1.07	4(4)
9	3.9(3)	0.65	1.28	5(8)
86	3.9(3)	0.67	1.28	5(8)
67	3.9(3)	0.63	1.28	5(8)
13	3.86(21)	0.86	1.28	5(6)
80	3.88(6)	3.07 Q	1.42	5.5(18)
5	3.9(4)	0.57	1.56	6(11)

continues

continued

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
27	3.9(4)	0.56	1.56	6(11)
4	3.9(15) Q	0.15	1.56	6(40)
83	4.00(20)	1.60	2.26	9(6)
15	4.06(16)	2.36	2.68 Q	10(5)
85	4.39(16)	4.39 D	5.00 D	19(5)
55	4.74(7)	14.10 D	7.45 D	28.9(21)

Table A48 – Ce-144 GH **assigned result 7.50(6) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
48	5.68(20)	-8.76 D	-4.94 D	-24(3)
53	7.0(3)	-2.06	-1.49	-7(4)
61	7.05(20)	-2.16	-1.22	-6(3)
45	7.1(4)	-1.04	-1.00	-5(5)
77	7.2(5)	-0.60	-0.73	-4(6)
55	7.27(21)	-1.05	-0.62	-3(3)
35	7.29(21)	-0.96	-0.57	-3(3)
68	7.3(3)	-0.65	-0.54	-3(4)
52	7.3(4)	-0.49	-0.54	-3(6)
80	7.32(19)	-0.90	-0.48	-2(3)
21	7.39(16)	-0.64	-0.29	-1.4(23)
27	7.4(8)	-0.13	-0.27	-1(10)
59	7.4(5)	-0.20	-0.24	-1(6)
87	7.4(3)	-0.22	-0.18	-1(4)
47	7.44(17)	-0.32	-0.16	-0.8(24)
86	7.5(6)	-0.09	-0.13	-1(7)
7	7.5(4)	-0.04	-0.05	0(6)
73	7.5(4)	0.00	0.01	0(6)
79	7.50(18)	0.01	0.01	0.0(25)
25	7.5(3)	0.04	0.03	0(5)
14	7.5(3)	0.04	0.03	0(4)
26	7.5(4)	0.13	0.11	1(5)
16	7.6(6)	0.23	0.33	2(7)
54	7.6(9)	0.15	0.39	2(12)
46	7.6(3)	0.50	0.39	2(4)
8	7.7(4)	0.57	0.58	3(5)
28	7.8(6)	0.51	0.77	4(8)
82	7.8(8)	0.37	0.79	4(10)
18	7.8(3)	0.99	0.82	4(4)
13	7.8(4)	0.75	0.82	4(6)
5	7.9(8)	0.52	1.12	5(11)
9	8.0(6)	0.88	1.39	7(8)
67	8.0(11)	0.48	1.42	7(14)
15	8.1(4)	1.39	1.53	7(6)
85	9.1(9)	1.86	4.24 Q	21(11)

Table A49 – Eu-152 GH **assigned result 18.99(14) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
25	14.3(12)	-4.01 D	-5.37 D	-25(6)
35	16.4(5)	-5.73 D	-2.94 D	-13.6(23)
45	17.5(12)	-1.33	-1.75	-8(6)
53	17.5(9)	-1.73	-1.69	-8(5)
52	17.5(9)	-1.63	-1.69	-8(5)
68	17.8(6)	-1.93	-1.35	-6(4)
86	17.8(12)	-0.92	-1.30	-6(7)
55	17.9(3)	-3.70 Q	-1.23	-5.7(15)
61	17.90(10)	-6.41 Q	-1.23	-5.7(9)
16	17.9(7)	-1.61	-1.23	-6(4)
7	18.0(10)	-0.98	-1.12	-5(6)
79	18.0(4)	-2.51	-1.10	-5.1(20)
28	18.1(13)	-0.68	-1.01	-5(7)
9	18.2(9)	-0.93	-0.91	-4(5)
47	18.21(21)	-3.10 Q	-0.88	-4.1(13)
87	18.3(4)	-1.66	-0.81	-3.8(23)
48	18.3(6)	-1.13	-0.81	-4(4)
73	18.3(9)	-0.75	-0.78	-4(5)
59	18.4(11)	-0.52	-0.62	-3(6)
21	18.6(4)	-0.91	-0.44	-2.0(22)
8	18.6(8)	-0.49	-0.44	-2(4)
54	18.6(4)	-0.86	-0.40	-1.9(22)
14	18.7(9)	-0.31	-0.30	-1(5)
82	18.8(19)	-0.10	-0.21	-1(10)
18	18.9(6)	-0.14	-0.10	0(4)
85	18.9(11)	-0.08	-0.10	0(6)
77	18.9(12)	-0.07	-0.10	0(6)
67	18.9(12)	-0.07	-0.09	0(6)
27	19.0(15)	0.01	0.02	0(8)
32	19.2(4)	0.47	0.20	0.9(19)
26	19.2(5)	0.43	0.25	1(3)
5	19.2(19)	0.12	0.27	1(10)
46	19.4(7)	0.67	0.52	2(4)
80	19.8(4)	1.98	0.97	4.5(23)
13	20.2(12)	1.01	1.38	6(7)
15	21.4(10)	2.39	2.74 Q	13(6)

Table A50 – Eu-155 GH **assigned result 3.72(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
48	2.87(10)	-8.31 D	-4.67 D	-23(3)
82	3.2(4)	-1.61	-2.92 Q	-14(9)
25	3.48(14)	-1.71	-1.34	-7(4)
35	3.51(10)	-2.07	-1.17	-6(3)
53	3.53(16)	-1.20	-1.06	-5(5)
79	3.55(11)	-1.54	-0.95	-5(3)
61	3.58(10)	-1.39	-0.79	-4(3)
9	3.63(20)	-0.45	-0.50	-2(6)
47	3.64(7)	-1.11	-0.45	-2.2(20)
87	3.65(17)	-0.43	-0.41	-2(5)
77	3.66(22)	-0.29	-0.35	-2(6)
21	3.69(9)	-0.37	-0.19	-0.9(25)
45	3.7(3)	-0.13	-0.19	-1(7)
8	3.71(18)	-0.08	-0.08	0(5)
32	3.78(18)	0.30	0.30	1(5)
73	3.80(20)	0.37	0.41	2(6)
86	3.8(4)	0.22	0.41	2(9)
55	3.81(21)	0.40	0.47	2(6)
67	3.8(3)	0.31	0.52	3(8)
80	3.82(11)	0.84	0.52	3(3)
26	3.84(14)	0.81	0.63	3(4)
18	3.90(17)	1.02	0.96	5(5)
7	3.90(22)	0.79	0.96	5(6)
52	3.90(20)	0.87	0.96	5(6)
28	3.9(3)	0.77	1.18	6(8)
14	3.95(18)	1.24	1.23	6(5)
59	3.95(23)	0.97	1.23	6(6)
54	4.0(4)	0.78	1.51	7(9)
46	4.02(16)	1.82	1.61	8(5)
13	4.03(23)	1.32	1.67	8(6)
5	4.0(4)	0.79	1.72	8(11)
27	4.1(5)	0.83	2.05	10(12)
68	4.13(17)	2.35	2.22	11(5)
15	4.22(21)	2.34	2.71 Q	13(6)

Table A51 – H-3 HTO B2 **assigned result 426(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
66	18(4)	-70.72 D	-14.11 D	-95.8(9)
5	1.7(3) × 10^{2}	-9.80 D	-8.82 D	-60(6)
40	476.4(13)	11.58 Q	1.74	11.8(11)
34T	517(25)	3.59 D	3.15 D	21(6)
4	5.6(7) × 10^{2}	1.82	4.60 Q	31(17)
38	5.8(5) × 10^{2}	2.97 D	5.15 D	35(12)
3	5.8(3) × 10^{2}	4.88 D	5.26 D	36(8)
28	581(16)	9.38 D	5.36 D	36(4)
29	6.0(3) × 10^{2}	5.75 D	6.02 D	41(7)
22	6.1(4) × 10^{2}	4.56 D	6.50 D	44(10)
81	6.2(5) × 10^{2}	3.77 D	6.68 D	45(12)
72	6.2(6) × 10^{2}	3.23 D	6.71 D	46(14)
25	6.3(3) × 10^{2}	7.23 D	7.14 D	48(7)
35	6.4(5) × 10^{2}	4.80 D	7.33 D	50(10)

Table A51* – H-3 total tritium B2 **assigned result 637(5) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
66	18(4)	-98.13 D	-14.32 D	-97.2(6)
5	1.7(3) × 10^{2}	-17.84 D	-10.78 D	-73(4)
40	476.4(13)	-31.83 D	-3.72 D	-25.2(6)
34T	517(25)	-4.72 D	-2.78 D	-19(4)
4	5.6(7) × 10^{2}	-1.07	-1.81	-12(11)
38	5.8(5) × 10^{2}	-1.24	-1.44	-10(8)
3	5.8(3) × 10^{2}	-1.89	-1.37	-9(5)
28	581(16)	-3.36 Q	-1.30	-9(3)
29	6.0(3) × 10^{2}	-1.22	-0.86	-6(5)
22	6.1(4) × 10^{2}	-0.56	-0.54	-4(7)
81	6.2(5) × 10^{2}	-0.36	-0.42	-3(8)
72	6.2(6) × 10^{2}	-0.29	-0.40	-3(9)
25	6.3(3) × 10^{2}	-0.16	-0.11	-1(5)
35	6.4(5) × 10^{2}	0.02	0.02	0(7)

Table A52 – H-3 OBT B2 **assigned result 211(3) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
35	1.2(7) × 10^2	-1.50	-3.04 Q	-5(3) × 10^1
5	4.5(7)× 10^2	3.55 D	7.61 D	11(4)× 10^1
38	6.3(8)× 10^2	5.13 D	13.13 D	20(4)× 10^1

Table A53 – C-14 B2 **assigned result 176.4(11) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
34P	59(3)	-36.90 D	-7.99 D	-66.6(17)
75C	79(13)	-7.47 D	-6.63 D	-55(8)
66P	82(10)	-9.39 D	-6.42 D	-54(6)
25C	92(6)	-14.83 D	-5.76 D	-48(4)
30	96(8)	-9.72 D	-5.47 D	-46(5)
38	128(18)	-2.68 D	-3.29 D	-27(10)
13C	135(11)	-3.81 D	-2.82 D	-23(6)
5C	150(22)	-1.18	-1.81	-15(13)
21P	154(6)	-3.68 Q	-1.52	-13(4)
40C	160(17)	-1.00	-1.12	-9(9)
16C	183(11)	0.60	0.45	4(6)
7C	188(14)	0.82	0.79	7(8)
35C	240(20)	3.18 D	4.33 D	36(11)

Table A54 – Cl-36 B2 **assigned result 402.2(25) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
30	293(20)	-5.33 D	-3.98 D	-27(5)
34	365(25)	-1.48	-1.35	-9(6)
66	3.9(5) × 10^2	-0.33	-0.55	-4(11)
8	404(25)	0.07	0.07	0(6)
38	413(17)	0.63	0.39	3(5)

Table A55 – I-129 B2 **assigned result 372(4) Bq kg^{-1}**

	Result (Bq kg^{-1})	Zeta score	*z*-score	Deviation (%)
34L	3.3(3) × 10^2	-1.48	-2.54	-11(8)
38G	360(10)	-1.10	-0.71	-3(3)
8L	363(10)	-0.79	-0.53	-2(3)
8G	364(16)	-0.47	-0.47	-2(5)
21G	372(9)	0.00	0.00	0(3)
46G	387(16)	0.93	0.93	4(5)
66L	4.0(5) × 10^2	0.50	1.48	7(13)
25G	4.0(4) × 10^2	0.67	1.51	7(10)
30G	430(21)	2.73 D	3.55 D	16(6)
3G	5.0(4) × 10^2	3.74 D	7.56 D	33(9)
40L	549(20)	8.52 D	10.78 D	48(6)

Table A56 – Total H-3 C **assigned result 8.9(15) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
4	3.5(9)	-3.03	-2.94	-60(12)
74	5.8(4)	-1.96	-1.71	-34(12)
35	6.2(5)	-1.69	-1.52	-31(13)
34	8.8(10)	-0.04	-0.12	-1(21)
29	9.0(7)	0.09	0.00	2(19)
32	9.9(11)	0.56	0.48	12(23)
38	11.1(13)	1.13	1.12	3(3) × 10^1
5	11.9(18)	1.31	1.56	3(3) × 10^1
17	13.5(20)	1.85	2.40	5(4) × 10^1

Critical value = **3.355**

Table A57 – Leachable H-3 C **assigned result 1.3(8) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
4	0.10(3)	-1.62	-1.08	-92(5)
29	0.45(4)	-1.15	-0.58	-66(20)
32	0.87(4)	-0.59	0.00	-3(4) × 10^1
5	5.4(8)	3.71	6.39 Q	3.1(24) × 10^2
40	79(5)	16.29 D	109.56 D	6(4) × 10^3

Critical value = **4.604**

Table A57A – Fixed H-3 C **assigned result 7.8(18) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
5	6.5(10)	-0.62	-0.62	-16(23)
32	9.0(11)	0.60	0.62	2(3) × 10^{1}

Critical value = **63.656**

Table A58 – C-14 C **assigned result 0.18(10) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
5	0.027(4)	-1.45	-1.14	-85(9)
32	0.034(3)	-1.38	-1.08	-81(11)
34	0.16(4)	-0.12	0.00	-1(6) × 10^{1}
17	0.24(4)	0.57	0.63	4(8) × 10^{1}
40	0.420(17)	2.32	2.12	14(14) × 10^{1}

Critical value = **4.604**

Table A59 – K-40 C **assigned result 0.20(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
58	0.1312(23)	-1.86	-1.43	-35(12)
3	0.148(12)	-1.35	-0.97	-27(15)
30	0.177(6)	-0.64	-0.18	-12(17)
66	0.190(20)	-0.27	0.18	-6(20)
17	0.35(4)	2.70	4.56 Q	7(4) × 10^{1}
86	0.35(3)	3.25	4.56 Q	7(4) × 10^{1}

Critical value = **4.032**

Table A60 – Ca-41 C **assigned result 0.41(15) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
32	0.24(4)	-1.10	-0.76	-41(24)
34	0.39(8)	-0.13	0.00	-1(4) × 10^{1}
38	0.60(10)	1.07	1.10	5(6) × 10^{1}

Critical value = **9.925**

Table A61 – Fe-55 C **assigned result 0.037(14) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
38	0.020(10)	-1.00	-0.79	-5(4) × 10^{1}
32	0.037(7)	0.01	0.00	0(5) × 10^{1}
34	0.054(12)	0.92	0.76	5(7) × 10^{1}

Critical value = **9.925**

Table A62 – Co-60 C **assigned result 0.0754(19) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
56	0.055(3)	-5.97 Q	-2.68	-27(5)
58	0.0610(4)	-7.42 Q	-1.87	-19.1(21)
84	0.0659(15)	-3.90 Q	-1.23	-13(3)
81	0.068(5)	-1.38	-0.96	-10(7)
53	0.070(4)	-1.51	-0.75	-8(5)
3	0.070(4)	-1.25	-0.72	-7(6)
8	0.070(4)	-1.36	-0.67	-7(5)
38	0.0710(20)	-1.58	-0.57	-6(4)
18	0.0723(20)	-1.11	-0.40	-4(4)
28	0.073(11)	-0.18	-0.25	-3(15)
21	0.0747(15)	-0.27	-0.09	-1(4)
85	0.075(4)	-0.12	-0.07	-1(6)
30	0.0750(12)	-0.16	-0.05	0(3)
29	0.075(9)	-0.04	-0.05	0(12)
34	0.076(9)	0.02	0.02	0(12)
52	0.076(4)	0.03	0.02	0(6)
5	0.076(8)	0.07	0.08	1(10)
35	0.0763(24)	0.31	0.12	1(4)
32	0.077(6)	0.21	0.16	2(8)
40	0.082(8)	0.80	0.84	9(11)
17	0.082(6)	1.05	0.86	9(9)
86	0.084(6)	1.34	1.10	11(9)
66	0.091(3)	4.48 Q	2.07	21(5)
54	0.099(5)	4.42 D	3.07 D	31(8)
48	0.120(13)	3.40 D	5.79 D	59(18)
4	0.15(6) Q	1.24	9.69 Q	10(8) × 10^{1}

Critical value = **2.787**

Table A63 – Ni-63 C **assigned result 0.0177(24) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
34	0.015(3)	-0.71	-0.76	-14(19)
38	0.017(9)	-0.08	0.00	0(5) × 10^1
32	0.57(5)	12.60 D	235.11 D	31(5) × 10^2

Critical value = **9.925**

Table A64 – Ba-133 C **assigned result 0.055(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
58	0.0430(11)	-4.17 Q	-1.32	-22(5)
34	0.044(7)	-1.40	-1.17	-19(13)
84	0.0455(22)	-2.76	-1.05	-17(6)
28	0.046(7)	-1.31	-1.01	-17(12)
81	0.046(3)	-2.25	-0.99	-16(7)
29	0.049(4)	-1.25	-0.66	-11(9)
56	0.049(4)	-1.40	-0.66	-11(8)
52	0.051(3)	-1.19	-0.49	-8(7)
8	0.051(3)	-1.00	-0.44	-7(7)
35	0.0514(16)	-1.17	-0.40	-7(6)
53	0.0522(24)	-0.79	-0.31	-5(7)
3	0.053(3)	-0.46	-0.20	-3(7)
17	0.054(4)	-0.21	-0.11	-2(9)
30	0.055(4)	-0.01	0.00	0(8)
18	0.0557(17)	0.21	0.07	1(6)
32	0.057(6)	0.32	0.22	4(11)
21	0.0579(23)	0.82	0.32	5(7)
85	0.062(4)	1.54	0.80	13(9)
86	0.064(5)	1.59	0.93	15(10)
5	0.065(7)	1.47	1.14	19(13)
40	0.067(7)	1.77	1.35	22(13)
66	0.0765(21)	6.33 Q	2.36	39(8)
38	0.083(3)	6.97 D	3.07 D	51(9)
54	0.088(7)	4.40 D	3.62 D	60(15)

Critical value = **2.807**

Table A65 – Cs-137 C **assigned result 0.00110(18) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
3	0.00097(23)	-0.43	-0.62	-11(25)
58	0.0012(4)	0.32	0.62	1(4) × 10^{1}

Critical value = **63.656**

Table A66 – Eu-152 C **assigned result 1.17(13) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
48	0.0850(20)	-8.04 D	-5.18 D	-92.7(9)
17	0.91(4)	-1.83	-1.23	-22(10)
56	0.95(3)	-1.56	-1.03	-18(10)
28	0.98(14)	-0.96	-0.89	-16(15)
81	0.98(7)	-1.23	-0.89	-16(11)
58	1.015(4)	-1.13	-0.73	-13(10)
34	1.02(16)	-0.70	-0.70	-13(17)
84	1.03(6)	-0.93	-0.65	-12(11)
3	1.08(8)	-0.57	-0.43	-8(13)
53	1.09(5)	-0.50	-0.35	-6(12)
29	1.10(10)	-0.40	-0.32	-6(14)
35	1.12(3)	-0.34	-0.22	-4(11)
52	1.16(6)	-0.03	-0.02	0(13)
8	1.17(5)	0.02	0.02	0(12)
18	1.199(16)	0.24	0.16	3(12)
40	1.20(11)	0.19	0.16	3(15)
32	1.202(23)	0.26	0.17	3(12)
21	1.24(3)	0.53	0.35	6(13)
30	1.27(8)	0.67	0.50	9(14)
86	1.38(10)	1.28	1.02	18(16)
5	1.38(14)	1.13	1.04	19(18)
85	1.39(14)	1.17	1.08	19(18)
66	1.61(3)	3.19 Q	2.10	38(16)
54	1.77(4)	4.29 D	2.87 D	51(18)
38	2.07(5)	6.30 D	4.32 D	77(21)

Critical value = **2.797**

Table A67 – Eu-154 C **assigned result 0.048(5) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
81	0.035(3)	-2.17	-2.38	-26(10)
58	0.0366(7)	-2.19	-2.08	-23(8)
28	0.040(6)	-1.01	-1.43	-16(15)
84	0.041(4)	-1.03	-1.24	-14(12)
53	0.043(4)	-0.86	-0.96	-11(11)
3	0.043(3)	-0.75	-0.81	-9(11)
35	0.0451(18)	-0.47	-0.47	-5(11)
52	0.0454(23)	-0.40	-0.41	-5(11)
21	0.0463(17)	-0.24	-0.24	-3(11)
40	0.047(5)	-0.03	-0.03	0(14)
8	0.048(5)	0.09	0.12	1(14)
66	0.049(4)	0.22	0.27	3(14)
18	0.049(3)	0.25	0.27	3(12)
29	0.049(4)	0.22	0.27	3(14)
30	0.050(5)	0.37	0.46	5(14)
85	0.050(6)	0.35	0.52	6(17)
86	0.051(4)	0.54	0.65	7(14)
5	0.052(5)	0.62	0.84	9(16)
32	0.064(11)	1.36	3.11 Q	3(3) × 10^{1}
38	0.104(4)	8.85 D	10.67 D	119(24)
34	0.13(3)	2.81	16.16 Q	18(7) × 10^{1}

Critical value = **2.845**

Table A68 – Pb-210 C **assigned result 0.60(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
84	0.60(3)	–	–	–

Table A69 – Ra-226 C **assigned result 0.05020(14) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
85	0.05(6)	0.00	-0.62	0(11) × 10^{1}
58	0.050(6)	0.02	0.62	0(12)

Critical value = **63.656**

Table A70 – Ra-228 C **assigned result 0.0102(17) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
30	0.0090(9)	-0.63	-0.62	-12(17)
58	0.0115(9)	0.62	0.62	12(21)

Critical value = **63.656**

Table A71 – Th-228 C **assigned result 0.0060(3) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
58	0.0060(3)	–	–	–

Table A72 – Th-234 C **assigned result 0.037(4) Bq g^{-1}**

	Result (Bq g^{-1})	Zeta score	*z*-score	Deviation (%)
30	0.037(4)	–	–	–

Appendix B. Results sorted by laboratory

Table B1 – Laboratory 3

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 BL	9.7(8)	8.11(6)	1.98	1.58	19(10)
Sr-89 BL	8.6(25)	15.90(10)	-2.92 D	-2.65 D	-46(16)
Sr-90 BL	13.2(10)	13.37(3)	-0.19	-0.18	-1(7)
gross β BL	42.4(23)	43(10)	-0.02	-0.08	-1(23)
H-3 HTO B2	58(3) × 10^{1}	426(4)	4.88 D	5.26 D	36(8)
H-3 total	58(3) × 10^{1}	637(5)*	-1.89	-1.37	-9(5)
I-129 B2	496(33)	372(4)	3.74 D	7.56 D	33(9)
	(Bq g^{-1})	(Bq g^{-1})			
K-40 C	0.148(12)	0.18(4)	-1.35	-0.72	-27(15)
Co-58 C	0.0073(16)	–			
Co-60 C	0.070(4)	0.0754(19)	-1.25	-0.72	-7(6)
Ba-133 C	0.053(3)	0.055(3)	-0.46	-0.20	-3(7)
Cs-137 C	0.0012(4)	0.00110(18)	-0.43	-0.62	-11(25)
Eu-152 C	1.08(8)	1.17(13)	-0.57	-0.43	-8(13)
Eu-154 C	0.043(3)	0.048(5)	-0.75	-0.81	-9(11)

Table B2 – Laboratory 4

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
U-238 AL	3.8(7) Q	3.72(9)	0.11	0.33	2(19)
Pu-238 AL	17.1(17)	17.13(8)	-0.01	-0.03	0(10)
Pu-239 AL	19.3(19)	19.59(12)	-0.15	-0.29	-1(10)
Am-241 AL	10.9(13)	10.07(4)	0.64	1.48	8(13)
H-3 BL	6.8(20)	8.11(6)	-0.66	-1.33	-16(25)
H-3 HTO B2	56(7) × 10^1	426(4)	1.82	4.60	31(17)
H-3 total B2	56(7) × 10^1	637(5)*	-1.07	-1.81	-12(11)
K-40 GL	5.3(24)	–			
Co-60 GL	12.5(24) Q	11.72(4)	0.33	1.22	7(20)
Cs-137 GL	9.7(20) Q	8.84(6)	0.43	1.56	10(23)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16(4) Q	16.32(5)	0.02	0.12	1(21)
Cs-137 GH	3.9(15) Q	3.68(3)	0.15	1.56	6(40)
Am-241 GH	0.40(15)	–			
H-3 total C	3.5(9)	8.9(15)	-3.03	-1.47	-60(12)
H-3 leach C	0.10(3)	1.3(8)	-1.62	-0.90	-92(5)
Co-60 C	0.15(6)	0.0754(19)	1.24	9.69 Q	10(8) × 10^1

Table B3 – Laboratory 5

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 D BL	16.3(16)	8.11(6)	5.02 D	8.27 D	101(20)
H-3 C BL	11.7(18)	8.11(6)	2.04	3.63 Q	44(22)
H-3 HTO B2	17(3) × 10^1	426(4)	-9.80 D	-8.82 D	-60(6)
H-3 total B2	17(3) × 10^1	637(5)*	-17.84 D	-10.78 D	-73(4)
OBT B2	452(68)	211(3)	3.55 D	7.61 D	114(32)
C-14 B2	150(22)	176.4(11)	-1.18	-1.81	-15(13)
Co-60 GL	12.5(13)	11.72(4)	0.65	1.29	7(11)
Zr-95 GL	5.2(5)	4.21(5)	1.83	2.30	23(12)
Nb-95 GL	11.4(11)	7.38(10)	3.51 D	7.75 D	54(16)
Sb-125 GL	13.0(13)	13.43(7)	-0.36	-0.56	-3(10)
Ba-133 GL	3.7(4)	4.15(3)	-1.28	-1.73	-11(9)
Cs-134 GL	3.5(4)	3.95(3)	-1.37	-1.75	-12(9)
Cs-137 GL	8.6(9)	8.84(6)	-0.32	-0.50	-3(10)
Ce-144 GL	14.5(15)	14.80(10)	-0.20	-0.27	-2(10)
Eu-152 GL	17.4(17)	17.91(12)	-0.27	-0.46	-3(10)
Eu-155 GL	6.0(6)	6.18(5)	-0.32	-0.39	-3(10)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	2.8(3)	2.720(19)	0.44	0.94	5(10)
H-3 BH	2.7(4)	2.720(19)	-0.02	-0.07	0(15)
Co-60 GH	16.9(17)	16.32(5)	0.36	0.92	4(10)
Zr-95 GH	7.2(7)	6.82(8)	0.46	1.23	5(11)
Nb-95 GH	15.8(16)	11.94(16)	2.41	6.01 Q	32(13)
Sb-125 GH	17.5(18)	17.23(8)	0.16	0.39	2(10)
Ba-133 GH	4.0(4)	4.07(3)	-0.27	-0.59	-3(10)
Cs-134 GH	1.05(11)	1.127(8)	-0.70	-1.55	-7(10)
Cs-137 GH	3.9(4)	3.68(3)	0.57	1.56	6(11)
Ce-144 GH	7.9(8)	7.50(6)	0.52	1.12	5(11)
Eu-152 GH	19.2(19)	18.99(14)	0.12	0.27	1(10)
Eu-155 GH	4.0(4)	3.72(3)	0.79	1.72	8(11)
H-3 leach C	5.4(8)	1.3(8)	3.71	3.06	31(24) × 10^1
H-3 fixed C	6.5(10)	7.8(18)	-0.62	-0.62	-16(23)
H-3 total C	11.9(18)	8.9(15)	1.31	0.84	3(3) × 10^1

continues

continued

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
C-14 C	0.027(4)	0.18(10)	-1.45	-0.81	-85(9)
Co-60 C	0.076(8)	0.0754(19)	0.07	0.08	1(10)
Ba-133 C	0.065(7)	0.055(3)	1.47	1.14	19(13)
Eu-152 C	1.38(14)	1.17(13)	1.13	1.04	19(18)
Eu-154 C	0.052(5)	0.048(5)	0.62	0.84	9(16)

Table B4 − Laboratory 7

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.1(7)	11.72(4)	-0.89	-0.98	-5(6)
Zr-95 GL	4.5(9)	4.21(5)	0.32	0.67	7(20)
Nb-95 GL	8.5(9)	7.38(10)	1.19	2.18	15(13)
Sb-125 GL	14.8(13)	13.43(7)	1.03	1.62	10(10)
Ba-133 GL	3.9(4)	4.15(3)	-0.79	-1.11	-7(9)
Cs-134 GL	4.8(7)	3.95(3)	1.14	2.91 Q	20(18)
Cs-137 GL	8.9(7)	8.84(6)	0.05	0.06	0(8)
Ce-144 GL	16.0(16)	14.80(10)	0.77	1.13	8(10)
Eu-152 GL	20.0(17)	17.91(12)	1.26	2.01	12(9)
Eu-155 GL	7.4(10)	6.18(5)	1.23	2.51	20(16)
C-14 B2	188(14)	176.4(11)	0.82	0.79	7(8)
	(Bq g^{-1})	(Bq g^{-1})			
Am-241 AH	4.10(17)	3.858(8)	1.47	1.50	6(5)
Cm-244 AH	17.4(6)	17.23(6)	0.31	0.19	1(4)
Fe-55 BH	4.9(5)	5.55(10)	-1.47	-1.60	-12(8)
Ni-63 BH	13.7(7)	9.8(4)	4.92 D	8.00 D	40(9)
Sr-90 BH	13.2(10)	17.06(3)	-3.86 D	-5.39 D	-23(6)
Co-60 GH	16.0(9)	16.32(5)	-0.37	-0.48	-2(5)
Zr-95 GH	6.9(4)	6.82(8)	0.14	0.20	1(6)
Nb-95 GH	13.0(7)	11.94(16)	1.44	1.64	9(6)
Sb-125 GH	16.4(9)	17.23(8)	-0.93	-1.14	-5(5)
Ba-133 GH	3.55(20)	4.07(3)	-2.62 D	-2.85 D	-13(5)
Cs-134 GH	1.02(6)	1.127(8)	-1.93	-2.15	-10(5)
Cs-137 GH	3.61(20)	3.68(3)	-0.34	-0.47	-2(6)
Ce-144 GH	7.5(4)	7.50(6)	-0.04	-0.05	0(6)
Eu-152 GH	18.0(10)	18.99(14)	-0.98	-1.12	-5(6)
Eu-155 GH	3.90(22)	3.72(3)	0.79	0.96	5(6)

Table B5 — Laboratory 8

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	10(5) Q	9.99(13)	0.05	0.30	2(45)
U-238 ASAL	4.07(16)	3.72(9)	1.91	1.48	9(5)
U-238 M AL	3.960(9)	3.72(9)	2.79 Q	1.01	6.4(24)
Pu-238 AL	18.1(16)	17.13(8)	0.61	1.02	6(9)
Pu-239 AL	21.6(19)	19.59(12)	1.06	1.99	10(10)
Am-241 AL	8.8(7)	10.07(4)	-1.77	-2.28	-13(7)
Cm-244 AL	8.6(8)	13.20(6)	-5.75 D	-5.90 D	-35(6)
H-3 BL	5.0(5)	8.11(6)	-6.90 D	-3.16 D	-38(6)
Sr-90 BL	14.90(24)	13.37(3)	6.34 Q	1.50	11.4(18)
Tc-99 BL	15.2(16)	16.45(4)	-0.77	-0.77	-8(10)
Cl-36 B2	404(25)	402.2(25)	0.07	0.07	0(6)
I-129 B2	363(10)	372(4)	-0.79	-0.53	-2(3)
I-129 B2	364(16)	372(4)	-0.47	-0.47	-2(5)
Co-60 GL	12.1(10)	11.72(4)	0.37	0.59	3(9)
Zr-95 GL	4.2(8)	4.21(5)	0.01	0.02	0(18)
Nb-95 GL	4.16(23)	7.38(10)	-12.85 D	-6.22 D	-44(4)
Sb-125 GL	13.6(17)	13.43(7)	0.09	0.18	1(12)
Ba-133 GL	3.9(5)	4.15(3)	-0.51	-0.97	-6(13)
Cs-134 GL	3.7(5)	3.95(3)	-0.64	-1.10	-8(12)
Cs-137 GL	9.1(9)	8.84(6)	0.28	0.44	3(10)
Ce-144 GL	16(3)	14.80(10)	0.34	0.85	6(18)
Eu-152 GL	18.1(20)	17.91(12)	0.09	0.18	1(11)
Eu-155 GL	6.0(11)	6.18(5)	-0.13	-0.29	-2(18)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	5.6(23) Q	4.84(7)	0.33	2.58	16(47)
Np-237 AH	17.6(13)	16.63(17)	0.74	0.78	6(8)
U-238A AH	2.52(10)	2.02(5)	4.78 D	5.09 D	25(6)
U-238M AH	2.040(8)	2.02(5)	0.46	0.21	1.0(23)
Pu-238 AH	18.5(16)	16.93(5)	1.01	1.79	9(9)
Pu-239 AH	8.5(8)	7.91(4)	0.82	1.43	8(9)
Am-241A AH	3.9(3)	3.858(8)	0.27	0.51	2(8)
Am-241G AH	3.69(15)	3.858(8)	-1.09	-1.04	-4(4)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Cm-244 AH	14.9(11)	17.23(6)	-2.20	-2.64 Q	-14(6)
H-3 BH	2.8(4)	2.720(19)	0.27	0.68	3(12)
Sr-90 BH	19(6) Q	17.06(3)	0.34	2.56	11(32)
Tc-99 BH	5.8(6)	6.501(15)	-1.18	-1.61	-11(9)
Co-60 GH	16.1(7)	16.32(5)	-0.33	-0.33	-1(4)
Zr-95 GH	6.8(4)	6.82(8)	-0.17	-0.21	-1(5)
Nb-95 GH	10.2(5)	11.94(16)	-3.32 D	-2.74 D	-15(5)
Sb-125 GH	17.4(10)	17.23(8)	0.16	0.21	1(6)
Ba-133 GH	3.84(21)	4.07(3)	-1.07	-1.25	-6(5)
Cs-134 GH	1.14(6)	1.127(8)	0.21	0.26	1(6)
Cs-137 GH	3.65(17)	3.68(3)	-0.16	-0.19	-1(5)
Ce-144 GH	7.7(4)	7.50(6)	0.57	0.58	3(5)
Eu-152 GH	18.6(8)	18.99(14)	-0.49	-0.44	-2(4)
Eu-155 GH	3.71(18)	3.72(3)	-0.08	-0.08	0(5)
Co-60 C	0.070(4)	0.0754(19)	-1.36	-0.67	-7(5)
Ba-133 C	0.051(3)	0.055(3)	-1.00	-0.44	-7(7)
Eu-152 C	1.17(5)	1.17(13)	0.02	0.02	0(12)
Eu-154 C	0.048(5)	0.048(5)	0.09	0.12	1(14)

Table B6 – Laboratory 9

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.3(10)	16.32(5)	-0.01	-0.02	0(6)
Zr-95 GH	7.1(5)	6.82(8)	0.55	1.06	4(8)
Nb-95 GH	6.9(5)	11.94(16)	-9.51 D	-7.85 D	-42(5)
Sb-125 GH	17.6(10)	17.23(8)	0.40	0.54	2(6)
Ba-133 GH	3.9(3)	4.07(3)	-0.76	-1.10	-5(7)
Cs-134 GH	1.03(8)	1.127(8)	-1.24	-1.95	-9(7)
Cs-137 GH	3.9(3)	3.68(3)	0.65	1.28	5(8)
Ce-144 GH	8.0(6)	7.50(6)	0.88	1.39	7(8)
Eu-152 GH	18.2(9)	18.99(14)	-0.93	-0.91	-4(5)
Eu-155 GH	3.63(20)	3.72(3)	-0.45	-0.50	-2(6)

Table B7 — Laboratory 13

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
U-238 AL	3.5(4)	3.72(9)	-0.59	-0.91	-6(10)
Pu-238 AL	16.9(9)	17.13(8)	-0.25	-0.24	-1(6)
Pu-239 AL	19.3(10)	19.59(12)	-0.29	-0.29	-1(5)
Am-241 AL	10.3(5)	10.07(4)	0.47	0.42	2(5)
Cm-244 AL	13.8(6)	13.20(6)	0.99	0.77	5(5)
H-3 BL	8.4(7)	8.11(6)	0.42	0.30	4(9)
Sr-90 BL	13.0(9)	13.37(3)	-0.41	-0.37	-3(7)
Tc-99 BL	12.3(13)	16.45(4)	-3.17 Q	-2.55	-25(8)
C-14 B2	135(11)	176.4(11)	-3.81 D	-2.82 D	-23(6)
Co-60 GL	12.4(6)	11.72(4)	1.13	1.07	6(5)
Zr-95 GL	5.4(5)	4.21(5)	2.29	2.93 Q	29(13)
Nb-95 GL	6.7(11)	7.38(10)	-0.65	-1.41	-10(15)
Sb-125 GL	14.6(9)	13.43(7)	1.27	1.38	9(7)
Ba-133 GL	4.3(4)	4.15(3)	0.26	0.35	2(9)
Cs-134 GL	4.1(3)	3.95(3)	0.37	0.40	3(8)
Cs-137 GL	9.2(6)	8.84(6)	0.73	0.71	4(6)
Ce-144 GL	15.4(11)	14.80(10)	0.54	0.57	4(8)
Eu-152 GL	19.2(13)	17.91(12)	0.98	1.24	7(7)
Eu-155 GL	6.7(5)	6.18(5)	1.07	1.12	9(8)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.9(8)	16.32(5)	0.73	0.89	4(5)
Zr-95 GH	7.3(4)	6.82(8)	1.28	1.94	8(6)
Nb-95 GH	12.5(12)	11.94(16)	0.46	0.87	5(10)
Sb-125 GH	18.0(11)	17.23(8)	0.69	1.03	4(7)
Ba-133 GH	4.01(25)	4.07(3)	-0.23	-0.31	-1(6)
Cs-134 GH	1.16(6)	1.127(8)	0.54	0.66	3(6)
Cs-137 GH	3.86(21)	3.68(3)	0.86	1.28	5(6)
Ce-144 GH	7.8(4)	7.50(6)	0.75	0.82	4(6)
Eu-152 GH	20.2(12)	18.99(14)	1.01	1.38	6(7)
Eu-155 GH	4.03(23)	3.72(3)	1.32	1.67	8(6)

Table B8 — Laboratory 14

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Np-237 AH	16.7(14)	16.63(17)	0.03	0.03	0(8)
Pu-238 AH	14.5(14)	16.93(5)	-1.69	-2.74 Q	-14(8)
Pu-239 AH	7.4(9)	7.91(4)	-0.63	-1.29	-7(11)
Am-241 AH	4.6(6)	3.858(8)	1.17	4.42 Q	18(16)
Cm-244 AH	6.7(8)	17.23(6)	-13.86 D	-11.95 D	-61(5)
Sr-89 BH	7.5(11)	6.67(4)	0.72	1.08	12(17)
Sr-90 BH	15.0(25)	17.06(3)	-0.84	-2.89 Q	-12(15)
Co-60 GH	16.4(6)	16.32(5)	0.07	0.06	0(4)
Zr-95 GH	6.92(25)	6.82(8)	0.39	0.38	2(4)
Nb-95 GH	13.2(5)	11.94(16)	2.58 Q	1.89	10(4)
Sb-125 GH	17.1(8)	17.23(8)	-0.13	-0.14	-1(5)
Ba-133 GH	4.03(18)	4.07(3)	-0.20	-0.20	-1(5)
Cs-134 GH	1.13(5)	1.127(8)	0.05	0.05	0(5)
Cs-137 GH	3.83(13)	3.68(3)	1.15	1.07	4(4)
Ce-144 GH	7.5(3)	7.50(6)	0.04	0.03	0(4)
Eu-152 GH	18.7(9)	18.99(14)	-0.31	-0.30	-1(5)
Eu-155 GH	3.95(18)	3.72(3)	1.24	1.23	6(5)

Table B9 – Laboratory 15

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	12.4(7)	11.72(4)	0.95	0.99	5(6)
Zr-95 GL	4.6(5)	4.21(5)	0.77	0.83	8(11)
Nb-95 GL	8.6(5)	7.38(10)	2.34	2.39	17(7)
Sb-125 GL	15.0(9)	13.43(7)	1.67	1.84	11(7)
Ba-133 GL	4.6(3)	4.15(3)	1.39	1.48	10(7)
Cs-134 GL	4.6(3)	3.95(3)	2.09	2.22	15(8)
Cs-137 GL	9.5(5)	8.84(6)	1.36	1.14	7(6)
Ce-144 GL	16.4(13)	14.80(10)	1.18	1.48	11(9)
Eu-152 GL	19.7(12)	17.91(12)	1.55	1.73	10(7)
Eu-155 GL	6.9(6)	6.18(5)	1.27	1.41	11(9)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	17.5(9)	16.32(5)	1.31	1.80	7(6)
Zr-95 GH	7.5(3)	6.82(8)	2.13	2.45	10(5)
Nb-95 GH	14.3(6)	11.94(16)	3.80 D	3.70 D	20(6)
Sb-125 GH	18.9(8)	17.23(8)	2.06	2.25	10(5)
Ba-133 GH	4.48(18)	4.07(3)	2.27	2.28	10(5)
Cs-134 GH	1.25(5)	1.127(8)	2.42	2.46	11(5)
Cs-137 GH	4.06(16)	3.68(3)	2.36	2.68 Q	10(5)
Ce-144 GH	8.1(4)	7.50(6)	1.39	1.53	7(6)
Eu-152 GH	21.4(10)	18.99(14)	2.39	2.74 Q	13(6)
Eu-155 GH	4.22(21)	3.72(3)	2.34	2.71 Q	13(6)

Table B10 – Laboratory 16

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
C-14 B2	183(11)	176.4(11)	0.60	0.45	4(6)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	2.72(7)	2.720(19)	0.00	0.00	0(3)
Co-60 GH	16.6(4)	16.32(5)	0.87	0.43	1.7(20)
Zr-95 GH	7.12(22)	6.82(8)	1.29	1.12	4(4)
Nb-95 GH	14.3(4)	11.94(16)	6.43 D	3.70 D	20(4)
Sb-125 GH	17.2(6)	17.23(8)	-0.07	-0.06	0(4)
Ba-133 GH	3.89(24)	4.07(3)	-0.73	-0.98	-4(6)
Cs-134 GH	1.06(3)	1.127(8)	-2.16	-1.35	-6(3)
Cs-137 GH	3.82(9)	3.68(3)	1.52	1.00	4(3)
Ce-144 GH	7.6(5)	7.50(6)	0.23	0.33	2(7)
Eu-152 GH	17.9(7)	18.99(14)	-1.61	-1.23	-6(4)

Table B11 — Laboratory 17

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
U-238 AL	3.09(18)	3.72(9)	-3.18 D	-2.70 D	-17(5)
Pu-238 AL	18.0(12)	17.13(8)	0.72	0.90	5(7)
Pu-239 AL	20.5(13)	19.59(12)	0.64	0.86	4(7)
Am-241 AL	9.6(6)	10.07(4)	-0.79	-0.84	-5(6)
Cm-244 AL	7.2(5)	13.20(6)	-13.76 D	-7.72 D	-45(4)
H-3 BL	36(6)	8.11(6)	4.65 D	28.19 D	344(74)
Co-60 GL	11.0(10)	11.72(4)	-0.80	-1.21	-7(8)
Zr-95 GL	6.3(13)	4.21(5)	1.60	5.02 Q	50(31)
Nb-95 GL	14(3)	7.38(10)	2.26	12.50 Q	88(39)
Sb-125 GL	14.5(15)	13.43(7)	0.73	1.28	8(11)
Ba-133 GL	6.6(12)	4.15(3)	2.13	8.93 Q	59(28)
Cs-134 GL	3.3(5)	3.95(3)	-1.30	-2.37	-16(13)
Cs-137 GL	9.8(7)	8.84(6)	1.36	1.69	11(8)
Ce-144 GL	15(3)	14.80(10)	-0.01	-0.03	0(20)
Eu-152 GL	13.8(13)	17.91(12)	-3.12 D	-4.02 D	-23(8)
Eu-155 GL	7.1(13)	6.18(5)	0.69	1.87	15(22)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	4.8(4)	4.84(7)	-0.05	-0.07	0(8)
U-238 AH	1.77(10)	2.02(5)	-2.27	-2.53	-12(6)
Pu-238 AH	19.5(10)	16.93(5)	2.50	2.94 Q	15(6)
Pu-239 AH	9.1(5)	7.91(4)	2.42	2.84 Q	15(6)
Am-241 AH	3.52(19)	3.858(8)	-1.78	-2.10	-9(5)
Cm-244 AH	9.8(5)	17.23(6)	-14.23 D	-8.42 D	-43(3)
H-3 total C	13.5(20)	8.9(15)	1.85	1.28	5(4) × 10^1
C-14 C	0.24(4)	0.18(10)	0.57	0.34	4(8) × 10^1
K-40 C	0.35(4)	0.18(4)	2.70	2.01	7(4) × 10^1
Co-60 C	0.082(6)	0.0754(19)	1.05	0.86	9(9)
Ba-133 C	0.054(4)	0.055(3)	-0.21	-0.11	-2(9)
Eu-152 C	0.91(4)	1.17(13)	-1.83	-1.23	-22(10)

Table B12 – Laboratory 18

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.5(5)	16.32(5)	0.36	0.28	1(3)
Zr-95 GH	6.93(23)	6.82(8)	0.46	0.42	2(4)
Nb-95 GH	12.1(6)	11.94(16)	0.25	0.25	1(5)
Sb-125 GH	17.5(6)	17.23(8)	0.42	0.35	1(4)
Ba-133 GH	4.02(13)	4.07(3)	-0.35	-0.26	-1(4)
Cs-134 GH	1.15(4)	1.127(8)	0.56	0.46	2(4)
Cs-137 GH	3.78(12)	3.68(3)	0.84	0.72	3(4)
Ce-144 GH	7.8(3)	7.50(6)	0.99	0.82	4(4)
Eu-152 GH	18.9(6)	18.99(14)	-0.14	-0.10	0(4)
Eu-155 GH	3.90(17)	3.72(3)	1.02	0.96	5(5)
Co-60 C	0.0723(20)	0.0754(19)	-1.11	-0.40	-4(4)
Ba-133 C	0.0557(17)	0.055(3)	0.21	0.07	1(6)
Eu-152 C	1.199(16)	1.17(13)	0.24	0.16	3(12)
Eu-154 C	0.049(3)	0.048(5)	0.25	0.27	3(12)

Table B13 — Laboratory 19

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 BL	10(4)	8.11(6)	0.47	1.91	23(49)
Co-60 GL	11.2(3)	11.72(4)	-1.73	-0.82	-4(3)
Zr-95 GL	3.9(3)	4.21(5)	-1.03	-0.75	-7(7)
Nb-95 GL	8.0(3)	7.38(10)	1.95	1.19	8(5)
Sb-125 GL	12.6(5)	13.43(7)	-1.69	-1.03	-6(4)
Ba-133 GL	3.90(20)	4.15(3)	-1.26	-0.93	-6(5)
Cs-134 GL	3.50(20)	3.95(3)	-2.23	-1.64	-11(5)
Cs-137 GL	8.7(3)	8.84(6)	-0.45	-0.25	-2(4)
Ce-144 GL	13.7(7)	14.80(10)	-1.56	-1.04	-7(5)
Eu-152 GL	15.8(5)	17.91(12)	-4.11 Q	-2.04	-12(3)
Eu-155 GL	6.1(5)	6.18(5)	-0.16	-0.16	-1(8)

Table B14 — Laboratory 21

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 BL	12.7(17)	8.11(6)	2.70 D	4.64 D	57(21)
C-14 B2	154(6)	176.4(11)	-3.68 Q	-1.52	-13(4)
I-129 B2	372(9)	372(4)	0.00	0.00	0(3)
Co-60 GL	11.80(20)	11.72(4)	0.38	0.12	0.7(17)
Zr-95 GL	4.31(21)	4.21(5)	0.45	0.23	2(5)
Nb-95 GL	7.6(4)	7.38(10)	0.53	0.36	3(5)
Sb-125 GL	13.9(4)	13.43(7)	1.10	0.54	3(3)
Ba-133 GL	4.17(17)	4.15(3)	0.09	0.06	0(4)
Cs-134 GL	3.92(11)	3.95(3)	-0.27	-0.11	-1(3)
Cs-137 GL	8.80(19)	8.84(6)	-0.19	-0.07	-0.4(23)
Ce-144 GL	15.1(6)	14.80(10)	0.49	0.28	2(4)
Eu-152 GL	17.7(5)	17.91(12)	-0.42	-0.21	-1(3)
Eu-155 GL	6.5(5)	6.18(5)	0.62	0.57	5(7)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	3.6(6)	4.84(7)	-2.11	-4.19 Q	-25(12)
Np-237 AH	18.6(11)	16.63(17)	1.77	1.59	12(7)
U-238 AH	1.81(18)	2.02(5)	-1.13	-2.12	-10(9)
Am-241 AH	3.76(9)	3.858(8)	-1.08	-0.61	-2.5(23)
H-3 BH	2.57(9)	2.720(19)	-1.63	-1.13	-6(4)
Fe-55 BH	4.4(3)	5.55(10)	-3.64 D	-2.70 D	-21(6)
Co-60 GH	16.3(3)	16.32(5)	-0.06	-0.03	-0.1(19)
Zr-95 GH	6.76(14)	6.82(8)	-0.35	-0.21	-0.8(24)
Nb-95 GH	12.00(20)	11.94(16)	0.22	0.09	0.5(21)
Sb-125 GH	17.1(3)	17.23(8)	-0.46	-0.19	-0.8(18)
Ba-133 GH	3.98(8)	4.07(3)	-1.03	-0.48	-2.1(21)
Cs-134 GH	1.110(20)	1.127(8)	-0.80	-0.35	-1.5(19)
Cs-137 GH	3.72(11)	3.68(3)	0.38	0.30	1(3)
Ce-144 GH	7.39(16)	7.50(6)	-0.64	-0.29	-1.4(23)
Eu-152 GH	18.6(4)	18.99(14)	-0.91	-0.44	-2.0(22)
Eu-155 GH	3.69(9)	3.72(3)	-0.37	-0.19	-0.9(25)
Co-58 C	0.0084(6)	–			
Co-60 C	0.0747(15)	0.0754(19)	-0.27	-0.09	-1(4)
Ba-133 C	0.0579(23)	0.055(3)	0.82	0.32	5(7)
Eu-152 C	1.24(3)	1.17(13)	0.53	0.35	6(13)
Eu-154 C	0.0463(17)	0.048(5)	-0.24	-0.24	-3(11)

Table B15 — Laboratory 22

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	10.3(6)	9.99(13)	0.53	0.43	3(6)
U-238 AL	3.6(3)	3.72(9)	-0.57	-0.74	-5(8)
Pu-238 AL	16.5(12)	17.13(8)	-0.51	-0.66	-4(7)
Pu-239 AL	18.8(14)	19.59(12)	-0.57	-0.79	-4(7)
Am-241 A AL	10.5(8)	10.07(4)	0.55	0.77	4(8)
Am-241 G AL	10.9(6)	10.07(4)	1.39	1.48	8(6)
Cm-244 AL	12.8(9)	13.20(6)	-0.43	-0.52	-3(7)
Sr-89 3M BL	19.0(20)	15.90(10)	1.56	1.13	20(13)
Sr-89 Ei BL	22(4)	15.90(10)	1.61	2.21	38(24)
Sr-90 3M BL	12.0(9)	13.37(3)	-1.48	-1.34	-10(7)
Sr-90 Ei BL	10.7(18)	13.37(3)	-1.48	-2.63 Q	-20(13)
H-3 HTO B2	61(4) × 10^1	426(4)	4.56 D	6.50 D	44(10)
H-3 HTO B2	61(4) × 10^1	637(5)*	-0.56	-0.54	-4(7)
Co-60 GL	12.2(5)	11.72(4)	0.95	0.75	4(5)
Zr-95 GL	4.4(3)	4.21(5)	0.61	0.45	4(7)
Nb-95 GL	7.4(4)	7.38(10)	0.04	0.04	0(6)
Sb-125 GL	14.6(7)	13.43(7)	1.63	1.38	9(5)
Ba-133 GL	4.20(20)	4.15(3)	0.23	0.17	1(5)
Cs-134 GL	4.40(20)	3.95(3)	2.22	1.64	11(5)
Cs-137 GL	9.1(4)	8.84(6)	0.65	0.47	3(5)
Ce-144 GL	14.5(10)	14.80(10)	-0.30	-0.28	-2(7)
Eu-152 GL	17.8(6)	17.91(12)	-0.19	-0.11	-1(4)
Eu-155 GL	6.6(6)	6.18(5)	0.70	0.86	7(10)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	5.3(3)	4.84(7)	1.37	1.42	9(7)
U-238 AH	1.81(15)	2.02(5)	-1.33	-2.12	-10(8)
Pu-238 AH	16.6(13)	16.93(5)	-0.25	-0.37	-2(8)
Pu-239 AH	7.7(6)	7.91(4)	-0.41	-0.62	-3(8)
Am-241A AH	4.1(4)	3.858(8)	0.61	1.25	5(9)
Am-241G AH	4.1(3)	3.858(8)	0.85	0.80	6(7)
Cm-244 AH	16.9(13)	17.23(6)	-0.26	-0.37	-2(7)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
H-3 BH	2.78(22)	2.720(19)	0.27	0.45	2(8)
Sr-89 3M BH	7.2(9)	6.67(4)	0.64	0.77	9(13)
Sr-89 Ei BH	22(4)	6.67(4)	4.26 D	20.20 D	224(52)
Sr-90 3M BH	16.3(11)	17.06(3)	-0.66	-1.02	-4(7)
Sr-90 Ei BH	11.8(19)	17.06(3)	-2.77 D	-7.35 D	-31(11)

Table B16 ─ Laboratory 23

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.4(8)	11.72(4)	-0.40	-0.51	-3(7)
Zr-95 GL	4.2(5)	4.21(5)	-0.03	-0.03	0(12)
Nb-95 GL	10.8(9)	7.38(10)	3.77 D	6.60 D	46(12)
Sb-125 GL	13.6(9)	13.43(7)	0.16	0.18	1(7)
Ba-133 GL	4.0(4)	4.15(3)	-0.39	-0.56	-4(10)
Cs-134 GL	4.2(5)	3.95(3)	0.50	0.91	6(12)
Cs-137 GL	8.9(8)	8.84(6)	0.08	0.11	1(9)
Ce-144 GL	14.3(9)	14.80(10)	-0.55	-0.47	-3(6)
Eu-152 GL	15.4(10)	17.91(12)	-2.50	-2.42	-14(6)
Eu-155 GL	6.3(5)	6.18(5)	0.24	0.24	2(8)

Table B17 — Laboratory 25

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	10.1(6)	9.99(13)	0.15	0.12	1(6)
U-238 AL	3.01(22)	3.72(9)	-3.03 D	-3.05 D	-19(6)
Pu-238 AL	16.9(11)	17.13(8)	-0.19	-0.20	-1(6)
Pu-239 AL	19.4(12)	19.59(12)	-0.20	-0.23	-1(6)
Am-241 AL	9.6(6)	10.07(4)	-0.79	-0.84	-5(6)
Cm-244 AL	12.2(8)	13.20(6)	-1.28	-1.25	-7(6)
gross α AL	122(10)	93(17)	1.51	5.99 Q	3(3) × 10^{1}
H-3 BL	10(3)	8.11(6)	0.55	1.65	20(37)
Sr-90 BL	12.6(10)	13.37(3)	-0.81	-0.76	-6(7)
gross β BL	46(4)	43(10)	0.30	1.00	7(25)
Co-60 GL	12.0(6)	11.72(4)	0.43	0.37	2(5)
Zr-95 GL	5.2(5)	4.21(5)	1.83	2.25	22(12)
Nb-95 GL	10.9(9)	7.38(10)	3.82 D	6.75 D	47(12)
Sb-125 GL	12.8(7)	13.43(7)	-0.90	-0.78	-5(6)
Ba-133 GL	3.84(25)	4.15(3)	-1.25	-1.15	-8(6)
Cs-134 GL	3.5(3)	3.95(3)	-1.62	-1.72	-12(8)
Cs-137 GL	8.8(4)	8.84(6)	-0.14	-0.10	-1(5)
Ce-144 GL	14.9(10)	14.80(10)	0.07	0.07	0(7)
Eu-152 GL	12.8(10)	17.91(12)	-5.17 D	-4.97 D	-29(6)
Eu-155 GL	6.0(4)	6.18(5)	-0.41	-0.33	-3(7)
H-3 HTO B2	63(3) × 10^{1}	426(4)	7.23 D	7.14 D	48(7)
H-3 total B2	63(3) × 10^{1}	637(5)	-0.16	-0.11	-1(5)
C-14 B2	92(6)	176.4(11)	-14.83 D	-5.76 D	-48(4)
I-129 B2	396(37)	372(4)	0.67	1.51	7(10)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	15.8(7)	16.32(5)	-0.72	-0.73	-3(4)
Zr-95 GH	7.0(3)	6.82(8)	0.48	0.57	2(5)
Nb-95 GH	12.7(10)	11.94(16)	0.78	1.20	6(8)
Sb-125 GH	16.5(7)	17.23(8)	-1.14	-1.08	-5(4)
Ba-133 GH	3.67(16)	4.07(3)	-2.44	-2.19	-10(4)
Cs-134 GH	1.00(9)	1.127(8)	-1.41	-2.55	-11(8)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Cs-137 GH	3.62(15)	3.68(3)	-0.37	-0.40	-2(4)
Ce-144 GH	7.5(3)	7.50(6)	0.04	0.03	0(5)
Eu-152 GH	14.3(12)	18.99(14)	-4.01 D	-5.37 D	-25(6)
Eu-155 GH	3.48(14)	3.72(3)	-1.71	-1.34	-7(4)

Table B18 — Laboratory 26

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	10.5(5)	9.99(13)	1.07	0.70	5(5)
U-238 AL	3.66(24)	3.72(9)	-0.25	-0.27	-2(7)
Pu-238 AL	12.3(5)	17.13(8)	-10.50 D	-5.04 D	-28(3)
Pu-239 AL	14.7(5)	19.59(12)	-9.31 D	-4.84 D	-25(3)
Am-241 AL	11.6(5)	10.07(4)	3.00 D	2.77 D	16(5)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.5(9)	16.32(5)	0.15	0.20	1(6)
Zr-95 GH	6.8(3)	6.82(8)	-0.02	-0.03	0(4)
Nb-95 GH	12.0(11)	11.94(16)	0.05	0.09	0(9)
I-125 GH	1.1(4)	–			
Sb-125 GH	17.1(5)	17.23(8)	-0.25	-0.15	-1(3)
Ba-133 GH	4.22(17)	4.07(3)	0.89	0.84	4(5)
Cs-134 GH	1.12(4)	1.127(8)	-0.18	-0.15	-1(4)
Cs-137 GH	3.76(14)	3.68(3)	0.58	0.58	2(4)
Ce-144 GH	7.5(4)	7.50(6)	0.13	0.11	1(5)
Eu-152 GH	19.2(5)	18.99(14)	0.43	0.25	1(3)
Eu-155 GH	3.84(14)	3.72(3)	0.81	0.63	3(4)

Table B19 — Laboratory 27

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.7(13)	11.72(4)	-0.02	-0.04	0(11)
Zr-95 GL	3.9(6)	4.21(5)	-0.52	-0.75	-7(14)
Nb-95 GL	5.6(7)	7.38(10)	-2.52	-3.44 Q	-24(10)
Sb-125 GL	11.2(16)	13.43(7)	-1.45	-2.72 Q	-17(12)
Ba-133 GL	3.7(5)	4.15(3)	-0.91	-1.66	-11(12)
Cs-134 GL	2.9(5)	3.95(3)	-2.10	-3.83 Q	-27(13)
Cs-137 GL	8.5(10)	8.84(6)	-0.34	-0.61	-4(11)
Ce-144 GL	15.5(25)	14.80(10)	0.29	0.66	5(17)
Eu-152 GL	12.6(5)	17.91(12)	-10.32 D	-5.12 D	-30(3)
Eu-155 GL	8.8(15)	6.18(5)	1.81	5.34 Q	42(23)
	(Bq g^{-1})	(Bq g^{-1})			
Cr-51 GH	2.20(25)	–			
Co-60 GH	16.3(17)	16.32(5)	-0.01	-0.03	0(10)
Zr-95 GH	5.4(6)	6.82(8)	-2.55	-5.24 Q	-21(8)
Nb-95 GH	10.2(11)	11.94(16)	-1.67	-2.78 Q	-15(9)
Sb-125 GH	16.2(17)	17.23(8)	-0.61	-1.42	-6(10)
Ba-133 GH	3.5(4)	4.07(3)	-1.61	-3.13 Q	-14(9)
Cs-134 GH	1.00(10)	1.127(8)	-1.27	-2.55	-11(9)
Cs-137 GH	3.9(4)	3.68(3)	0.56	1.56	6(11)
Ce-144 GH	7.4(8)	7.50(6)	-0.13	-0.27	-1(10)
Eu-152 GH	19.0(15)	18.99(14)	0.01	0.02	0(8)
Eu-155 GH	4.1(5)	3.72(3)	0.83	2.05	10(12)

Table B20 − Laboratory 28

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	13.3(13)	9.99(13)	2.54	4.60 Q	33(13)
U-238 AL	3.78(10)	3.72(9)	0.44	0.24	2(4)
Pu-238 AL	17.8(6)	17.13(8)	1.17	0.74	4(4)
Pu-239 AL	19.9(4)	19.59(12)	0.72	0.28	1.5(20)
Am-241 AL	10.8(9)	10.07(4)	0.86	1.30	7(9)
Cm-244 AL	13.0(8)	13.20(6)	-0.27	-0.26	-2(6)
H-3 BL	16.4(20)	8.11(6)	4.14 D	8.38 D	102(25)
Sr-90 BL	16.5(17)	13.37(3)	1.84	3.08 Q	23(13)
Tc-99 BL	16.9(7)	16.45(4)	0.68	0.27	3(4)
H-3 HTO B2	581(16)	426(4)	9.38 D	5.36 D	36(4)
H-3 total B2	581(16)	637(5)	-3.36 Q	-1.30	-9(3)
Co-60 GL	12.1(9)	11.72(4)	0.44	0.59	3(7)
Zr-95 GL	4.4(3)	4.21(5)	0.53	0.40	4(8)
Nb-95 GL	14.6(11)	7.38(10)	6.54 D	13.93	98(15)
Sb-125 GL	12.8(9)	13.43(7)	-0.69	-0.75	-5(7)
Ba-133 GL	3.7(3)	4.15(3)	-1.58	-1.51	-10(6)
Cs-134 GL	3.60(25)	3.95(3)	-1.40	-1.28	-9(7)
Cs-137 GL	9.1(7)	8.84(6)	0.38	0.44	3(7)
Ce-144 GL	14.9(10)	14.80(10)	0.10	0.09	1(7)
Eu-152 GL	16.1(12)	17.91(12)	-1.50	-1.75	-10(7)
Eu-155 GL	6.6(5)	6.18(5)	0.84	0.79	6(7)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	4.6(10) Q	4.84(7)	-0.23	-0.79	-5(21)
U-238 AH	1.84(19)	2.02(5)	-0.92	-1.82	-9(10)
Pu-238 AH	17.5(6)	16.93(5)	1.02	0.70	4(4)
Pu-239 AH	7.97(11)	7.91(4)	0.52	0.14	0.8(15)
Am-241 AH	4.01(19)	3.858(8)	0.80	0.94	4(5)
Cm-244 AH	15.4(11)	17.23(6)	-1.66	-2.07	-11(7)
H-3 BH	2.76(3)	2.720(19)	1.25	0.30	1.5(12)
Sr-90 BH	18.0(11)	17.06(3)	0.85	1.31	5(7)
Tc-99 BH	6.2(4)	6.501(15)	-0.63	-0.60	-4(7)
Co-58 GH	0.104(7)	–			

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Co-60 GH	16.7(12)	16.32(5)	0.32	0.58	2(8)
Zr-95 GH	7.0(5)	6.82(8)	0.37	0.68	3(7)
Nb-95 GH	20.6(15)	11.94(16)	5.74 D	13.59 D	72(13)
Sb-125 GH	17.0(12)	17.23(8)	-0.20	-0.33	-1(7)
Ba-133 GH	3.8(3)	4.07(3)	-1.17	-1.75	-8(7)
Cs-134 GH	1.06(8)	1.127(8)	-0.89	-1.35	-6(7)
Cs-137 GH	3.8(3)	3.68(3)	0.45	0.86	3(8)
Ce-144 GH	7.8(6)	7.50(6)	0.51	0.77	4(8)
Eu-152 GH	18.1(13)	18.99(14)	-0.68	-1.01	-5(7)
Eu-155 GH	3.9(3)	3.72(3)	0.77	1.18	6(8)
Am-241 GH	0.286(21)	–			
Co-60 C	0.073(11)	0.0754(19)	-0.18	-0.25	-3(15)
Ba-133 C	0.046(7)	0.055(3)	-1.31	-1.01	-17(12)
Eu-152 C	0.98(14)	1.17(13)	-0.96	-0.89	-16(15)
Eu-154 C	0.040(6)	0.048(5)	-1.01	-1.43	-16(15)

Table B21 — Laboratory 29

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
U-238 AL	4.00(20)	3.72(9)	1.28	1.18	7(6)
Pu-238 AL	18.0(10)	17.13(8)	0.87	0.92	5(6)
Pu-239 AL	20.0(10)	19.59(12)	0.40	0.40	2(5)
Am-241 AL	10.0(5)	10.07(4)	-0.13	-0.12	-1(5)
H-3 HTO B2	60(3) × 10^1	426(4)	5.75 D	6.02 D	41(7)
H-3 total B2	60(3) × 10^1	637(5)	-1.22	-0.86	-6(5)
Co-60 GL	8.7(10)	11.72(4)	-3.02 D	-4.75 D	-26(9)
Zr-95 GL	2.9(3)	4.21(5)	-4.32 D	-3.18 D	-31(7)
Nb-95 GL	5.4(6)	7.38(10)	-3.26 D	-3.94 D	-27(8)
Sb-125 GL	10.2(8)	13.43(7)	-4.05 D	-3.92 D	-24(6)
Ba-133 GL	3.1(3)	4.15(3)	-3.50 D	-3.85 D	-25(7)
Cs-134 GL	2.9(3)	3.95(3)	-3.49 D	-3.83 D	-27(8)
Cs-137 GL	6.5(5)	8.84(6)	-4.64 D	-4.41 D	-26(6)
Ce-144 GL	10.7(10)	14.80(10)	-4.08 D	-3.88 D	-28(7)
Eu-152 GL	12.6(10)	17.91(12)	-5.28 D	-5.34 D	-30(6)
Eu-155 GL	4.7(4)	6.18(5)	-3.68 D	-3.02 D	-24(7)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 leach C	0.45(4)	1.3(8)	-1.15	-0.64	-66(20)
H-3 total C	9.0(7)	8.9(15)	0.09	0.04	2(19)
Co-60 C	0.075(9)	0.0754(19)	-0.04	-0.05	0(12)
Ba-133 C	0.049(4)	0.055(3)	-1.25	-0.66	-11(9)
Eu-152 C	1.10(10)	1.17(13)	-0.40	-0.32	-6(14)
Eu-154 C	0.049(4)	0.048(5)	0.22	0.27	3(14)

Table B22 – Laboratory 30

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	12.6(4)	11.72(4)	2.13	1.38	7(4)
Zr-95 GL	4.60(14)	4.21(5)	2.60 Q	0.93	9(4)
Nb-95 GL	8.3(4)	7.38(10)	2.74 Q	1.77	12(5)
Sb-125 GL	13.9(4)	13.43(7)	1.19	0.54	3(3)
Ba-133 GL	4.10(22)	4.15(3)	-0.25	-0.20	-1(6)
Cs-134 GL	4.20(16)	3.95(3)	1.53	0.91	6(4)
Cs-137 GL	9.5(3)	8.84(6)	2.31	1.20	7(4)
Ce-144 GL	16.6(9)	14.80(10)	1.96	1.70	12(6)
Eu-152 GL	19.0(11)	17.91(12)	0.98	1.05	6(6)
Eu-155 GL	6.7(4)	6.18(5)	1.47	1.06	8(6)
C-14 B2	96(8)	176.4(11)	-9.72 D	-5.47 D	-46(5)
Cl-36 B2	293(20)	402.2(25)	-5.33 D	-3.98 D	-27(5)
I-129 B2	430(21)	372(4)	2.73 D	3.55 D	16(6)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	25.5(10)	2.720(19)	22.33 D	171.80 D	838(38)
Fe-55 BH	9.0(11)	5.55(10)	3.13 D	8.15 D	62(20)
Sr-89 BH	7.5(3)	6.67(4)	2.73 Q	1.12	12(5)
Sr-90 BH	17.6(4)	17.06(3)	1.34	0.75	3.1(24)
K-40 C	0.177(6)	0.18(4)	-0.64	-0.33	-12(17)
Co-60 C	0.0750(12)	0.0754(19)	-0.16	-0.05	0(3)
Ba-133 C	0.055(4)	0.055(3)	-0.01	0.00	0(8)
Eu-152 C	1.27(8)	1.17(13)	0.67	0.50	9(14)
Eu-154 C	0.050(5)	0.048(5)	0.37	0.46	5(14)
Ra-228 C	0.0090(9)	0.0102(17)	-0.63	-0.62	-12(17)
Th-234 C	0.037(4)	–			

Table B23 – Laboratory 32

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 BL	8.2(13)	8.11(6)	0.07	0.09	1(16)
Fe-55 BL	10.7(14)	10.42(18)	0.20	0.18	3(14)
Ni-63 BL	10.3(11)	8.6(4)	1.49	1.74	20(14)
Sr-89 BL	14.8(14)	15.90(10)	-0.78	-0.40	-7(9)
Sr-90 BL	13.7(10)	13.37(3)	0.36	0.34	3(7)
Tc-99 BL	15.0(11)	16.45(4)	-1.32	-0.89	-9(7)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	4.61(16)	4.84(7)	-1.34	-0.79	-5(4)
Ra-226 G AH	4.86(23)	4.84(7)	0.08	0.06	0(5)
Np-237 AH	18.2(23)	16.63(17)	0.66	1.24	9(14)
U-238A AH	1.97(4)	2.02(5)	-0.85	-0.52	-3(3)
U-238M AH	1.97(16)	2.02(5)	-0.29	-0.50	-2(8)
Pu-238 AH	16.3(3)	16.93(5)	-1.96	-0.70	-3.6(19)
Pu-239 AH	7.56(15)	7.91(4)	-2.25	-0.83	-4.4(20)
Am-241A AH	3.61(9)	3.858(8)	-2.61 Q	-1.53	-6.4(24)
Am-241G AH	4.00(7)	3.858(8)	2.06	0.85	3.6(17)
Cm-244 AH	16.2(4)	17.23(6)	-2.54	-1.13	-5.8(23)
gross α AH	72(4)	75(8)	-0.33	-0.79	-4(11)
Co-60 GH	16.4(3)	16.32(5)	0.44	0.19	0.7(17)
Zr-95 GH	6.79(15)	6.82(8)	-0.16	-0.10	-0.4(25)
Nb-95 GH	11.8(8)	11.94(16)	-0.19	-0.23	-1(7)
Sb-125 GH	16.9(4)	17.23(8)	-0.89	-0.41	-1.8(20)
Ba-133 GH	4.05(8)	4.07(3)	-0.16	-0.07	-0.3(19)
Cs-134 GH	1.10(4)	1.127(8)	-0.83	-0.57	-3(3)
Cs-137 GH	3.71(7)	3.68(3)	0.45	0.23	0.9(20)
Eu-152 GH	19.2(4)	18.99(14)	0.47	0.20	0.9(19)
Eu-155 GH	3.78(18)	3.72(3)	0.30	0.30	1(5)
H-3 leach C	0.87(4)	1.3(8)	-0.59	-0.33	$-3(4) \times 10^1$
H-3 fixed C	9.0(11)	7.8(18)	0.60	0.62	$2(3) \times 10^1$
H-3 total C	9.9(11)	8.9(15)	0.56	0.29	12(23)
C-14 C	0.034(3)	0.18(10)	-1.38	-0.77	-81(11)
Ca-41 C	0.24(5)	0.41(15)	-1.10	-0.82	-41(24)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Fe-55 C	0.037(7)	0.037(14)	0.01	0.01	0(5) × 10[1]
Co-60 C	0.077(6)	0.0754(19)	0.21	0.16	2(8)
Ni-63 C	0.57(5)	0.0177(24)	12.60 D	164.81 D	31(5) × 10[2]
Ba-133 C	0.057(6)	0.055(3)	0.32	0.22	4(11)
Eu-152 C	1.202(23)	1.17(13)	0.26	0.17	3(12)
Eu-154 C	0.064(11)	0.048(5)	1.36	3.11 Q	3(3) × 10[1]

Table B24 – Laboratory 34

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	9.3(11)	9.99(13)	-0.65	-0.99	-7(11)
Np-237 AL	7.2(11)	8.60(9)	-1.27	-1.12	-16(13)
U-238 AL	3.8(3)	3.72(9)	0.41	0.50	3(8)
Pu-238 AL	17.7(18)	17.13(8)	0.32	0.60	3(11)
Pu-239 AL	20.0(20)	19.59(12)	0.20	0.40	2(10)
Am-241 AL	10.0(10)	10.07(4)	-0.06	-0.12	-1(10)
Cm-244 AL	13.4(13)	13.20(6)	0.15	0.25	1(10)
Fe-55 BL	11.8(19)	10.42(18)	0.72	0.91	13(18)
Ni-63 BL	7.3(9)	8.6(4)	-1.38	-1.34	-15(11)
Sr-90 BL	13.2(20)	13.37(3)	-0.09	-0.17	-1(15)
Tc-99 BL	16.5(17)	16.45(4)	0.03	0.03	0(10)
H-3 HTO B2	517(25)	426(4)	3.59 D	3.15 D	21(6)
H-3 total B2	517(25)	637(5)	-4.72 D	-2.78	-19(4)
C-14 B2	59(3)	176.4(11)	-36.90 D	-7.99 D	-66.6(17)
Cl-36 B2	365(25)	402.2(25)	-1.48	-1.35	-9(6)
I-129 B2	330(28)	372(4)	-1.48	-2.54	-11(8)
Co-60 GL	12.1(12)	11.72(4)	0.31	0.59	3(10)
Zr-95 GL	5.8(12)	4.21(5)	1.35	3.77 Q	37(28)
Nb-95 GL	15(4)	7.38(10)	2.28	14.51 Q	102(45)
Sb-125 GL	16(4)	13.43(7)	0.86	3.43 Q	21(25)
Ba-133 GL	3.8(8)	4.15(3)	-0.53	-1.44	-9(18)
Cs-134 GL	3.9(4)	3.95(3)	-0.11	-0.15	-1(10)
Cs-137 GL	9.3(9)	8.84(6)	0.54	0.91	6(11)
Ce-144 GL	16(4)	14.80(10)	0.29	0.85	6(21)
Eu-152 GL Q	15(4)	17.91(12)	-0.81	-2.42	-14(17)
Eu-155 GL	6.9(14)	6.18(5)	0.50	1.41	11(22)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 total C	8.8(10)	8.9(15)	-0.04	-0.02	-1(21)
C-14 C	0.16(4)	0.18(10)	-0.12	-0.07	-1(6) × 10^{1}
Ca-41 C	0.39(8)	0.41(15)	-0.13	-0.11	-1(4) × 10^{1}
Fe-55 C	0.054(12)	0.037(14)	0.92	0.88	5(7) × 10^{1}

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Co-60 C	0.076(9)	0.0754(19)	0.02	0.02	0(12)
Ni-63 C	0.015(3)	0.0177(24)	-0.71	-0.75	-14(19)
Ba-133 C	0.044(7)	0.055(3)	-1.40	-1.17	-19(13)
Eu-152 C	1.02(16)	1.17(13)	-0.70	-0.70	-13(17)
Eu-154 C	0.13(3)	0.048(5)	2.81	16.16 Q	$18(7) \times 10^1$

Table B25 – Laboratory 35

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	6.9(5)	9.99(13)	-6.02 D	-4.24 D	-31(5)
U-238 AL	3.83(14)	3.72(9)	0.65	0.46	3(5)
Pu-238 AL	17.4(6)	17.13(8)	0.48	0.29	2(4)
Pu-239 AL	19.8(7)	19.59(12)	0.29	0.19	1(4)
Am-241 AL	10.4(4)	10.07(4)	1.07	0.65	4(4)
Cm-244 AL	13.6(4)	13.20(6)	0.91	0.47	3(3)
H-3 BL	12.6(9)	8.11(6)	4.85 D	4.57 D	56(12)
Sr-90 BL	10.8(12)	13.37(3)	-2.14	-2.53	-19(9)
Tc-99 BL	17.5(10)	16.45(4)	1.05	0.64	6(6)
H-3 HTO B2	64(5) × 10^{1}	426(4)	4.80 D	7.33 D	50(10)
H-3 total B2	64(5) × 10^{1}	637(5)	0.02	0.02	0(7)
OBT B2	115(64)	211(3)	-1.50	-3.04 Q	-46(30)
C-14 B2	240(20)	176.4(11)	3.18 D	4.33 D	36(11)
Co-60 GL	11.9(4)	11.72(4)	0.49	0.28	2(3)
Zr-95 GL	4.37(24)	4.21(5)	0.64	0.38	4(6)
Nb-95 GL	10.5(4)	7.38(10)	7.39 D	6.02 D	42(6)
Sb-125 GL	13.6(5)	13.43(7)	0.33	0.18	1(4)
Ba-133 GL	3.62(15)	4.15(3)	-3.50 Q	-1.95	-13(4)
Cs-134 GL	3.73(18)	3.95(3)	-1.21	-0.81	-6(5)
Cs-137 GL	8.9(3)	8.84(6)	0.20	0.11	1(4)
Ce-144 GL	15.7(7)	14.80(10)	1.27	0.85	6(5)
Eu-152 GL	16.3(5)	17.91(12)	-3.39 Q	-1.56	-9(3)
Eu-155 GL	6.11(22)	6.18(5)	-0.31	-0.14	-1(4)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	3.84(8)	4.84(7)	-10.03 D	-3.40 D	-20.7(19)
U-238 AH	2.00(6)	2.02(5)	-0.27	-0.19	-1(4)
Pu-238 AH	16.1(5)	16.93(5)	-1.71	-0.92	-5(3)
Pu-239 AH	7.48(23)	7.91(4)	-1.84	-1.02	-5(3)
Am-241 AH	3.32(11)	3.858(8)	-4.88 D	-3.34 D	-14(3)
Cm-244 AH	15.0(4)	17.23(6)	-5.27 Q	-2.52	-12.9(25)
Co-60 GH	15.6(4)	16.32(5)	-1.74	-1.09	-4.4(25)
Zr-95 GH	6.79(18)	6.82(8)	-0.14	-0.10	0(3)

continues

continued

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Nb-95 GH	15.6(4)	11.94(16)	8.31 D	5.74 D	31(4)
Sb-125 GH	15.5(4)	17.23(8)	-4.27 Q	-2.36	-10.1(24)
Ba-133 GH	3.35(9)	4.07(3)	-7.61 D	-3.96 D	-17.6(23)
Cs-134 GH	1.01(3)	1.127(8)	-3.77 Q	-2.35	-10(3)
Cs-137 GH	3.61(10)	3.68(3)	-0.65	-0.47	-2(3)
Ce-144 GH	7.29(21)	7.50(6)	-0.96	-0.57	-3(3)
Eu-152 GH	16.4(5)	18.99(14)	-5.73 D	-2.94 D	-13.6(23)
Eu-155 GH	3.51(10)	3.72(3)	-2.07	-1.17	-6(3)
H-3 total C	6.2(5)	8.9(15)	-1.69	-0.74	-31(13)
Co-60 C	0.0763(24)	0.0754(19)	0.31	0.12	1(4)
Ba-133 C	0.0514(16)	0.055(3)	-1.17	-0.40	-7(6)
Eu-152 C	1.12(3)	1.17(13)	-0.34	-0.22	-4(11)
Eu-154 C	0.0451(18)	0.048(5)	-0.47	-0.47	-5(11)

Table B26 – Laboratory 38

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	10.0(10)	9.99(13)	0.01	0.02	0(10)
Np-237 AL	12.0(10)	8.60(9)	3.38 D	2.71 D	40(12)
U-238 AL	3.50(20)	3.72(9)	-1.03	-0.95	-6(6)
Pu-238 AL	18.0(10)	17.13(8)	0.87	0.92	5(6)
Pu-239 AL	20.0(10)	19.59(12)	0.40	0.40	2(5)
Am-241 AL	9.6(4)	10.07(4)	-1.16	-0.82	-5(4)
Cm-244 AL	10.8(4)	13.20(6)	-5.94 D	-3.11 D	-18(3)
H-3 HTO B2	58(5) × 10^{1}	426(4)	2.97 D	5.15 D	35(12)
H-3 total B2	58(5) × 10^{1}	637(5)*	-1.24	-1.44	-10(8)
OBT B2	627(81)	211(3)	5.13 D	13.13 D	197(39)
C-14 B2	128(18)	176.4(11)	-2.68 D	-3.29 D	-27(10)
Cl-36 B2	413(17)	402.2(25)	0.63	0.39	3(5)
I-129 B2	360(10)	372(4)	-1.10	-0.71	-3(3)
Co-60 GL	12.3(4)	11.72(4)	1.44	0.91	5(4)
Zr-95 GL	4.70(10)	4.21(5)	4.34 Q	1.17	12(3)
Sb-125 GL	13.4(5)	13.43(7)	-0.11	-0.07	0(4)
Ba-133 GL	4.5(3)	4.15(3)	1.15	1.26	8(7)
Cs-134 GL	4.3(3)	3.95(3)	1.16	1.27	9(8)
Cs-137 GL	9.4(4)	8.84(6)	1.39	1.02	6(5)
Ce-144 GL	14.6(7)	14.80(10)	-0.28	-0.19	-1(5)
Eu-152 GL	20.6(6)	17.91(12)	4.38 D	2.59 D	15(4)
Eu-155 GL	6.9(5)	6.18(5)	1.43	1.47	12(8)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	3.00(20)	2.720(19)	1.40	2.11	10(8)
H-3 C BH	3.1(4)	2.720(19)	0.95	2.87 Q	14(15)
Fe-55 BH	5.0(4)	5.55(10)	-1.33	-1.29	-10(8)
Ni-63 BH	10.0(9)	9.8(4)	0.25	0.49	2(10)
Sr-89 BH	6.0(6)	6.67(4)	-1.12	-0.91	-10(9)
Sr-90 BH	17.4(8)	17.06(3)	0.42	0.47	2(5)
Tc-99 BH	6.2(5)	6.501(15)	-0.60	-0.67	-5(8)
H-3 total C	11.1(13)	8.9(15)	1.13	0.62	3(3) × 10^{1}
Ca-41 C	0.60(10)	0.41(15)	1.07	0.93	5(6) × 10^{1}

continues

continued

	Result	Assigned result	Zeta score	z-score	Deviation (%)
Fe-55 C	0.020(10)	0.037(14)	-1.00	-0.89	$-5(4) \times 10^1$
Co-60 C	0.0710(20)	0.0754(19)	-1.58	-0.57	-6(4)
Ni-63 C	0.017(9)	0.0177(24)	-0.08	-0.22	$0(5) \times 10^1$
Ba-133 C	0.083(3)	0.055(3)	6.97 D	3.07 D	51(9)
Eu-152 C	2.07(5)	1.17(13)	6.30 D	4.32 D	77(21)
Eu-154 C	0.104(4)	0.048(5)	8.85 D	10.67 D	119(24)

Table B27 – Laboratory 39

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Pu-238 AL	17.2(16)	17.13(8)	0.05	0.08	0(9)
Pu-239 AL	19.6(19)	19.59(12)	0.00	0.01	0(10)
Co-60 GL	12.1(5)	11.72(4)	0.75	0.59	3(5)
Zr-95 GL	4.2(3)	4.21(5)	-0.04	-0.03	0(7)
Nb-95 GL	16.6(10)	7.38(10)	9.17 D	17.79 D	125(14)
Sb-125 GL	13.1(7)	13.43(7)	-0.50	-0.43	-3(5)
Ba-133 GL	4.10(20)	4.15(3)	-0.27	-0.20	-1(5)
Cs-134 GL	3.80(20)	3.95(3)	-0.75	-0.55	-4(5)
Cs-137 GL	8.9(6)	8.84(6)	0.10	0.11	1(7)
Ce-144 GL	13.8(12)	14.80(10)	-0.83	-0.95	-7(8)
Eu-152 GL	17.7(9)	17.91(12)	-0.24	-0.21	-1(5)
Eu-155 GL	6.8(4)	6.18(5)	1.54	1.26	10(7)

Table B28 – Laboratory 40

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	1.59(24)	9.99(13)	-30.64 D	-11.65 D	-84.1(24)
U-238 AL	3.28(9)	3.72(9)	-3.52 Q	-1.90	-12(4)
Pu-238 AL	14.5(4)	17.13(8)	-6.56 D	-2.73 D	-15.2(23)
Pu-239 AL	16.3(5)	19.59(12)	-7.35 D	-3.23 D	-16.6(22)
Am-241 AL	8.42(19)	10.07(4)	-8.46 D	-2.92 D	-16.4(19)
Cm-244 AL	11.37(25)	13.20(6)	-7.01 Q	-2.37	-13.9(20)
gross α AL	16.5(13)	93(17)	-4.48 D	-15.46 D	-82(4)
H-3 BL	41(5)	8.11(6)	6.95 D	33.07 D	403(58)
Sr-89 BL	9.2(16)	15.90(10)	-4.18 Q	-2.43	-42(10)
Sr-90 BL	10.8(19)	13.37(3)	-1.37	-2.53	-19(14)
gross β BL	35(10)	43(10)	-0.56	-2.60 Q	-2(3) × 10^1
H-3 HTO B2	476.4(13)	426(4)	11.58 Q	1.74	11.8(11)
H-3 total B2	476.4(13)	637(5)	-31.83 D	-3.72 D	-25.2(6)
C-14 B2	160(17)	176.4(11)	-1.00	-1.12	-9(9)
I-129 B2	549(20)	372(4)	8.52 D	10.78 D	48(6)
Co-60 GL	11.74(24)	11.72(4)	0.07	0.03	0.2(21)
Zr-95 GL	4.88(24)	4.21(5)	2.72 Q	1.60	16(6)
Nb-95 GL	8.65(24)	7.38(10)	4.88 Q	2.45	17(4)
Sb-125 GL	14.88(24)	13.43(7)	5.73 Q	1.72	10.6(19)
Ba-133 GL	3.71(24)	4.15(3)	-1.84	-1.62	-11(6)
Cs-134 GL	3.84(24)	3.95(3)	-0.46	-0.40	-3(6)
Cs-137 GL	8.86(24)	8.84(6)	0.09	0.04	0(3)
Ce-144 GL	15.86(24)	14.80(10)	4.05 Q	1.00	7.2(18)
Eu-152 GL	15.24(24)	17.91(12)	-9.92 D	-2.69 D	-14.9(15)
Eu-155 GL	6.07(24)	6.18(5)	-0.45	-0.23	-2(4)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 leach C	79(5)	1.3(8)	16.29 D	57.90 D	6(4) × 10^3
C-14 C	0.420(17)	0.18(10)	2.32	1.32	14(14) × 10^1
Co-60 C	0.082(8)	0.0754(19)	0.80	0.84	9(11)
Ba-133 C	0.067(7)	0.055(3)	1.77	1.35	22(13)
Eu-152 C	1.20(11)	1.17(13)	0.19	0.16	3(15)
Eu-154 C	0.047(5)	0.048(5)	-0.03	-0.03	0(14)

Table B29 – Laboratory 41

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	12.2(9)	11.72(4)	0.56	0.75	4(7)
Zr-95 GL	4.6(22) Q	4.21(5)	0.19	1.00	10(52)
Nb-95 GL	7.6(25)	7.38(10)	0.09	0.46	3(34)
Sb-125 GL	13.1(14)	13.43(7)	-0.25	-0.43	-3(11)
Ba-133 GL	4.6(10)	4.15(3)	0.46	1.66	11(24)
Cs-134 GL	3.6(6)	3.95(3)	-0.59	-1.35	-9(16)
Cs-137 GL	10(8) Q	8.84(6)	0.16	2.38	15(95)
Ce-144 GL	18(4)	14.80(10)	0.82	3.04 Q	22(26)
Eu-152 GL	13(5)	17.91(12)	-0.98	-4.29 Q	-25(25)
Eu-155 GL	7.3(14)	6.18(5)	0.84	2.34	19(22)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	2.84(7)	2.720(19)	1.73	0.91	4(3)
Sr-90 BH	21.4(10)	17.06(3)	4.25 D	6.06 D	25(6)
Pu-238 AH	16.0(6)	16.93(5)	-1.70	-1.05	-5(4)
Pu-239 AH	7.4(3)	7.91(4)	-1.93	-1.19	-6(4)
Am-241 AH	3.75(10)	3.858(8)	-1.05	-0.67	-3(3)
Cm-244 AH	15.9(4)	17.23(6)	-3.57 Q	-1.55	-8.0(22)

Table B30 – Laboratory 42

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	11(3)	9.99(13)	0.40	1.49	11(27)
Np-237 AL	11.2(19)	8.60(9)	1.37	2.04	30(22)
Am-241 AL	10.6(11)	10.07(4)	0.44	0.86	5(11)
gross α AL	28.42(21)	93(17)	-3.79 D	-13.05 D	-69(6)
Co-60 GL	11.9(12)	11.72(4)	0.11	0.22	1(10)
Zr-95 GL	4.3(5)	4.21(5)	0.10	0.11	1(11)
Nb-95 GL	9.7(10)	7.38(10)	2.28	4.55 Q	32(14)
Sb-125 GL	13.4(14)	13.43(7)	-0.06	-0.10	-1(10)
Ba-133 GL	3.8(4)	4.15(3)	-1.03	-1.48	-10(9)
Cs-134 GL	3.8(4)	3.95(3)	-0.38	-0.55	-4(10)
Cs-137 GL	9.2(10)	8.84(6)	0.42	0.73	5(11)
Ce-144 GL	14.2(16)	14.80(10)	-0.41	-0.60	-4(10)
Eu-152 GL	17.0(17)	17.91(12)	-0.53	-0.89	-5(10)
Eu-155 GL	6.2(8)	6.18(5)	0.06	0.10	1(13)

Table B31 – Laboratory 45

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	15.8(6)	16.32(5)	-0.92	-0.77	-3(4)
Zr-95 GH	6.95(25)	6.82(8)	0.51	0.49	2(4)
Nb-95 GH	11.9(7)	11.94(16)	-0.09	-0.10	-1(6)
Sb-125 GH	16.7(8)	17.23(8)	-0.60	-0.68	-3(5)
Ba-133 GH	3.59(23)	4.07(3)	-2.06	-2.63 Q	-12(6)
Cs-134 GH	1.17(10)	1.127(8)	0.43	0.86	4(9)
Cs-137 GH	3.72(13)	3.68(3)	0.32	0.30	1(4)
Ce-144 GH	7.1(4)	7.50(6)	-1.04	-1.00	-5(5)
Eu-152 GH	17.5(12)	18.99(14)	-1.33	-1.75	-8(6)
Eu-155 GH	3.7(3)	3.72(3)	-0.13	-0.19	-1(7)

Table B32 – Laboratory 46

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
I-129 B2	387(16)	372(4)	0.93	0.93	4(5)
Co-60 GL	11.4(5)	11.72(4)	-0.79	-0.57	-3(4)
Zr-95 GL	4.7(3)	4.21(5)	1.81	1.19	12(7)
Nb-95 GL	8.5(6)	7.38(10)	1.92	2.22	16(8)
Sb-125 GL	13.5(6)	13.43(7)	-0.01	-0.01	0(4)
Ba-133 GL	4.22(19)	4.15(3)	0.34	0.24	2(5)
Cs-134 GL	4.04(17)	3.95(3)	0.52	0.32	2(5)
Cs-137 GL	9.2(4)	8.84(6)	0.90	0.56	4(4)
Ce-144 GL	15.1(7)	14.80(10)	0.47	0.31	2(5)
Eu-152 GL	18.0(8)	17.91(12)	0.11	0.08	0(5)
Eu-155 GL	6.7(3)	6.18(5)	1.83	1.06	8(5)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	3.95(24)	4.84(7)	-3.59 D	-3.03 D	-18(5)
Tc-99 BH	5.93(23)	6.501(15)	-2.48	-1.27	-9(4)
Co-60 GH	16.6(6)	16.32(5)	0.53	0.46	2(4)
Zr-95 GH	6.87(24)	6.82(8)	0.21	0.20	1(4)
Nb-95 GH	12.4(8)	11.94(16)	0.61	0.76	4(7)
Sb-125 GH	17.2(6)	17.23(8)	-0.07	-0.06	0(4)
Ba-133 GH	4.03(14)	4.07(3)	-0.26	-0.20	-1(4)
Cs-134 GH	1.12(4)	1.127(8)	-0.18	-0.15	-1(4)
Cs-137 GH	3.72(13)	3.68(3)	0.32	0.30	1(4)
Ce-144 GH	7.6(3)	7.50(6)	0.50	0.39	2(4)
Eu-152 GH	19.4(7)	18.99(14)	0.67	0.52	2(4)
Eu-155 GH	4.02(16)	3.72(3)	1.82	1.61	8(5)

Table B33 – Laboratory 47

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	9.6(3)	9.99(13)	-1.38	-0.58	-4(3)
U-238A AL	3.50(22)	3.72(9)	-0.95	-0.95	-6(6)
U-238M AL	4.019(24)	3.72(9)	3.37 Q	1.26	8.0(25)
Pu-238 AL	17.1(5)	17.13(8)	-0.06	-0.03	0(3)
Pu-239 AL	19.3(5)	19.59(12)	-0.68	-0.34	-2(3)
Am-241 AL	10.16(21)	10.07(4)	0.45	0.17	0.9(21)
Cm-244 AL	12.67(25)	13.20(6)	-2.07	-0.69	-4.0(19)
Co-60 GL	10.9(8)	11.72(4)	-1.01	-1.29	-7(7)
Zr-95 GL	4.27(20)	4.21(5)	0.27	0.14	1(5)
Nb-95 GL	6.9(5)	7.38(10)	-1.09	-0.99	-7(7)
Sb-125 GL	12.9(5)	13.43(7)	-1.20	-0.64	-4(4)
Ba-133 GL	4.01(15)	4.15(3)	-0.95	-0.53	-3(4)
Cs-134 GL	3.72(13)	3.95(3)	-1.74	-0.84	-6(4)
Cs-137 GL	8.9(3)	8.84(6)	0.07	0.04	0(4)
Ce-144 GL	14.8(6)	14.80(10)	-0.03	-0.02	0(5)
Eu-152 GL	17.1(6)	17.91(12)	-1.44	-0.80	-5(4)
Eu-155 GL	6.3(3)	6.18(5)	0.55	0.30	2(5)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	4.98(23)	4.84(7)	0.56	0.46	3(5)
Np-237 AH	18(5)	16.63(17)	0.18	0.70	5(29)
U-238 AH	1.93(8)	2.02(5)	-1.01	-0.93	-5(5)
U-238 X AH	1.80(11)	2.02(5)	-1.84	-2.23	-11(6)
U-238M AH	1.931(9)	2.02(5)	-1.90	-0.89	-4.4(22)
Pu-238 AH	16.9(6)	16.93(5)	-0.14	-0.09	0(4)
Pu-239 AH	7.7(3)	7.91(4)	-0.82	-0.57	-3(4)
Am-241 AH	3.45(22)	3.858(8)	-1.85	-2.53	-11(6)
Cm-244 AH	14.83(23)	17.23(6)	-10.16 D	-2.72 D	-13.9(14)
Co-60 GH	16.0(5)	16.32(5)	-0.64	-0.45	-2(3)
Zr-95 GH	6.53(10)	6.82(8)	-2.26	-1.05	-4.2(18)
Nb-95 GH	11.8(3)	11.94(16)	-0.39	-0.21	-1(3)
Sb-125 GH	16.56(21)	17.23(8)	-3.03 Q	-0.93	-4.0(13)
Ba-133 GH	3.96(5)	4.07(3)	-1.86	-0.61	-2.7(14)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Cs-134 GH	1.062(14)	1.127(8)	-4.03 Q	-1.31	-5.8(14)
Cs-137 GH	3.61(6)	3.68(3)	-1.10	-0.49	-1.9(17)
Ce-144 GH	7.44(17)	7.50(6)	-0.32	-0.16	-0.8(24)
Eu-152 GH	18.21(21)	18.99(14)	-3.10 Q	-0.88	-4.1(13)
Eu-155 GH	3.64(7)	3.72(3)	-1.11	-0.45	-2.2(20)

Table B34 – Laboratory 48

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Cr-51 GH	2.0(5)	–			
Co-60 GH	13.7(5)	16.32(5)	-5.59 D	-3.94 D	-16(3)
Zr-95 GH	6.26(21)	6.82(8)	-2.48	-2.06	-8(4)
Nb-95 GH	10.9(4)	11.94(16)	-2.56	-1.62	-9(4)
Sb-125 GH	16.1(6)	17.23(8)	-2.09	-1.55	-7(4)
Ba-133 GH	3.92(13)	4.07(3)	-1.11	-0.81	-4(4)
Cs-134 GH	1.02(4)	1.127(8)	-2.63 Q	-2.15	-10(4)
Cs-137 GH	3.37(11)	3.68(3)	-2.70 Q	-2.15	-8(4)
Ce-144 GH	5.68(20)	7.50(6)	-8.76 D	-4.94 D	-24(3)
Eu-152 GH	18.3(6)	18.99(14)	-1.13	-0.81	-4(4)
Eu-155 GH	2.87(10)	3.72(3)	-8.31D	-4.67 D	-23(3)
Co-60 C	0.120(13)	0.0754(19)	3.40 D	5.79 D	59(18)
Eu-152 C	0.0850(20)	1.17(13)	-8.04 D	-5.18 D	-92.7(9)

Table B35 – Laboratory 52

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.9(5)	11.72(4)	0.35	0.28	2(5)
Zr-95 GL	4.20(20)	4.21(5)	-0.06	-0.03	0(5)
Nb-95 GL	7.0(4)	7.38(10)	-0.93	-0.74	-5(6)
Sb-125 GL	13.5(8)	13.43(7)	0.06	0.05	0(6)
Ba-133 GL	4.20(20)	4.15(3)	0.23	0.17	1(5)
Cs-134 GL	4.00(20)	3.95(3)	0.24	0.18	1(5)
Cs-137 GL	8.8(5)	8.84(6)	-0.08	-0.07	0(6)
Ce-144 GL	14.6(9)	14.80(10)	-0.22	-0.19	-1(6)
Eu-152 GL	16.9(9)	17.91(12)	-1.12	-0.98	-6(5)
Eu-155 GL	5.6(3)	6.18(5)	-1.91	-1.18	-9(5)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.2(7)	16.32(5)	-0.17	-0.18	-1(5)
Zr-95 GH	6.9(4)	6.82(8)	0.20	0.31	1(6)
Nb-95 GH	12.0(6)	11.94(16)	0.09	0.09	0(5)
Sb-125 GH	17.0(9)	17.23(8)	-0.27	-0.33	-1(5)
Ba-133 GH	3.80(20)	4.07(3)	-1.32	-1.47	-7(5)
Cs-134 GH	1.10(5)	1.127(8)	-0.54	-0.55	-2(5)
Cs-137 GH	3.70(20)	3.68(3)	0.11	0.16	1(6)
Ce-144 GH	7.3(4)	7.50(6)	-0.49	-0.54	-3(6)
Eu-152 GH	17.5(9)	18.99(14)	-1.63	-1.69	-8(5)
Eu-155 GH	3.90(20)	3.72(3)	0.87	0.96	5(6)
Co-60 C	0.076(4)	0.0754(19)	0.03	0.02	0(6)
Ba-133 C	0.051(3)	0.055(3)	-1.19	-0.49	-8(7)
Eu-152 C	1.16(6)	1.17(13)	-0.03	-0.02	0(13)
Eu-154 C	0.0454(23)	0.048(5)	-0.40	-0.41	-5(11)

Table B36 – Laboratory 53

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Tc-99 BL	17.4(14)	16.45(4)	0.68	0.58	6(9)
Co-60 GL	11.5(5)	11.72(4)	-0.44	-0.35	-2(5)
Zr-95 GL	4.1(3)	4.21(5)	-0.37	-0.27	-3(7)
Nb-95 GL	7.6(4)	7.38(10)	0.53	0.42	3(6)
Sb-125 GL	12.7(7)	13.43(7)	-1.07	-0.91	-6(5)
Ba-133 GL	3.80(15)	4.15(3)	-2.32	-1.30	-9(4)
Cs-134 GL	3.9(3)	3.95(3)	-0.19	-0.19	-1(7)
Cs-137 GL	8.9(4)	8.84(6)	0.15	0.11	1(5)
Ce-144 GL	13.9(9)	14.80(10)	-1.05	-0.90	-6(6)
Eu-152 GL	16.7(8)	17.91(12)	-1.50	-1.17	-7(5)
Eu-155 GL	5.5(4)	6.18(5)	-1.69	-1.39	-11(7)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	15.9(7)	16.32(5)	-0.65	-0.64	-3(4)
Zr-95 GH	6.6(4)	6.82(8)	-0.79	-0.99	-4(5)
Nb-95 GH	11.5(6)	11.94(16)	-0.74	-0.70	-4(5)
Sb-125 GH	16.2(7)	17.23(8)	-1.48	-1.42	-6(4)
Ba-133 GH	3.75(16)	4.07(3)	-1.95	-1.75	-8(4)
Cs-134 GH	1.03(5)	1.127(8)	-1.92	-1.95	-9(5)
Cs-137 GH	3.53(13)	3.68(3)	-1.11	-1.03	-4(4)
Ce-144 GH	7.0(3)	7.50(6)	-2.06	-1.49	-7(4)
Eu-152 GH	17.5(9)	18.99(14)	-1.73	-1.69	-8(5)
Eu-155 GH	3.53(16)	3.72(3)	-1.20	-1.06	-5(5)
Co-60 C	0.070(4)	0.0754(19)	-1.51	-0.75	-8(5)
Ba-133 C	0.0522(24)	0.055(3)	-0.79	-0.31	-5(7)
Eu-152 C	1.09(5)	1.17(13)	-0.50	-0.35	-6(12)
Eu-154 C	0.043(4)	0.048(5)	-0.86	-0.96	-11(12)

Table B37 – Laboratory 54

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.8(6)	11.72(4)	0.11	0.11	1(6)
Sb-125 GL	13.6(9)	13.43(7)	0.13	0.14	1(7)
Ba-133 GL	4.8(5)	4.15(3)	1.42	2.29	15(11)
Cs-134 GL	4.0(3)	3.95(3)	0.30	0.32	2(8)
Cs-137 GL	8.9(8)	8.84(6)	0.08	0.11	1(9)
Ce-144 GL	15.3(24)	14.80(10)	0.22	0.51	4(17)
Eu-152 GL	18.0(9)	17.91(12)	0.12	0.10	1(5)
Eu-155 GL	6.5(8)	6.18(5)	0.40	0.69	5(14)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	15.5(7)	16.32(5)	-1.25	-1.26	-5(4)
Sb-125 GH	17.0(5)	17.23(8)	-0.56	-0.40	-2(3)
Ba-133 GH	4.08(18)	4.07(3)	0.07	0.07	0(5)
Cs-134 GH	1.09(4)	1.127(8)	-0.91	-0.75	-3(4)
Cs-137 GH	3.66(25)	3.68(3)	-0.07	-0.12	0(7)
Ce-144 GH	7.6(9)	7.50(6)	0.15	0.39	2(12)
Eu-152 GH	18.6(4)	18.99(14)	-0.86	-0.40	-1.9(22)
Eu-155 GH	4.0(4)	3.72(3)	0.78	1.51	7(9)
Co-60 C	0.099(5)	0.0754(19)	4.42 D	3.07 D	31(8)
Ba-133 C	0.088(7)	0.055(3)	4.40 D	3.62 D	60(15)
Eu-152 C	1.77(4)	1.17(13)	4.29 D	2.87 D	51(18)

Table B38 – Laboratory 55

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	5.8(6)	4.84(7)	1.77	3.19 Q	19(11)
Np-237 AH	18.8(13)	16.63(17)	1.69	1.75	13(8)
U-238 AH	2.088(10)	2.02(5)	1.48	0.70	3.4(24)
Pu-238 AH	18.9(14)	16.93(5)	1.44	2.24	12(8)
Pu-238 AH	18.0(11)	16.93(5)	0.94	1.22	6(7)
Pu-239 AH	9.1(9)	7.91(4)	1.27	2.72 Q	14(11)
Pu-239 AH	8.4(6)	7.91(4)	0.88	1.12	6(7)
Am-241 AH	4.01(9)	3.858(8)	1.63	0.94	3.9(24)
Cm-244 AH	7.8(6)	17.23(6)	-17.81 D	-10.70 D	-55(3)
gross α AH	74.8(17)	75(8)	0.03	0.06	0(11)
H-3 BH	2.73(16)	2.720(19)	0.07	0.08	0(6)
Fe-55 BH	6.2(5)	5.55(10)	1.41	1.61	12(9)
Sr-89 BH	6.9(5)	6.67(4)	0.43	0.27	3(7)
Sr-90 BH	16.5(5)	17.06(3)	-1.24	-0.79	-3(3)
Tc-99 BH	6.2(4)	6.501(15)	-0.97	-0.72	-5(5)
Co-60 GH	16.20(17)	16.32(5)	-0.66	-0.18	-0.7(11)
Zr-95 GH	6.57(14)	6.82(8)	-1.53	-0.91	-3.6(23)
Nb-95 GH	12.1(3)	11.94(16)	0.49	0.25	1(3)
Sb-125 GH	16.7(4)	17.23(8)	-1.43	-0.74	-3.2(22)
Ba-133 GH	3.83(11)	4.07(3)	-2.09	-1.31	-6(3)
Cs-134 GH	1.13(4)	1.127(8)	0.07	0.05	0(4)
Cs-137 GH	4.74(7)	3.68(3)	14.10 D	7.45 D	28.9(21)
Ce-144 GH	7.27(21)	7.50(6)	-1.05	-0.62	-3(3)
Eu-152 GH	17.9(3)	18.99(14)	-3.70 Q	-1.23	-5.7(15)
Eu-155 GH	3.81(21)	3.72(3)	0.40	0.47	2(6)

Table B39 – Laboratory 56

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
gross α AL	72.8(23)	93(17)	-1.17	-4.07 Q	-22(15)
gross β BL	43(3)	43(10)	0.03	0.09	1(23)
Co-60 GL	7.1(7)	11.72(4)	-6.64 D	-7.32 D	-40(6)
Zr-95 GL	2.4(5)	4.21(5)	-4.07 D	-4.34 D	-43(10)
Nb-95 GL	11.0(13)	7.38(10)	2.78 D	7.04 D	49(18)
Sb-125 GL	9.7(7)	13.43(7)	-5.14 D	-4.54 D	-28(6)
Ba-133 GL	1.5(3)	4.15(3)	-10.30 D	-9.84 D	-65(6)
Cs-134 GL	2.39(23)	3.95(3)	-6.74 D	-5.69 D	-40(6)
Cs-137 GL	6.4(8)	8.84(6)	-3.26 D	-4.50 D	-28(9)
Ce-144 GL	9.0(21)	14.80(10)	-2.73 D	-5.48 D	-39(14)
Eu-152 GL	11.5(8)	17.91(12)	-8.44 D	-6.18 D	-36(5)
Eu-155 GL	3.1(4)	6.18(5)	-7.42 D	-6.24 D	-50(7)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 C	0.055(3)	0.0754(19)	-5.97 Q	-2.68	-27(5)
Ba-133 C	0.049(4)	0.055(3)	-1.40	-0.66	-11(8)
Eu-152 C	0.95(3)	1.17(13)	-1.56	-1.03	-18(10)

Table B40 – Laboratory 58

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	10.49(8)	11.72(4)	-14.03 Q	-1.94	-10.5(8)
Zr-95 GL	3.97(8)	4.21(5)	-2.57	-0.59	-5.8(22)
Nb-95 GL	6.34(12)	7.38(10)	-6.67 Q	-2.01	-14.1(20)
Sb-125 GL	12.07(18)	13.43(7)	-7.24 Q	-1.67	-10.3(14)
Ba-133 GL	3.46(7)	4.15(3)	-9.19 Q	-2.54	-16.7(18)
Cs-134 GL	3.44(7)	3.95(3)	-6.77 Q	-1.86	-12.9(19)
Cs-137 GL	7.85(9)	8.84(6)	-9.03 Q	-1.79	-11.2(12)
Ce-144 GL	13.2(4)	14.80(10)	-3.88 Q	-1.55	-11(3)
Eu-152 GL	16.01(17)	17.91(12)	-9.08 Q	-1.84	-10.6(11)
Eu-155 GL	5.1(3)	6.18(5)	-4.24 Q	-2.28	-18(5)
	(Bq g^{-1})	(Bq g^{-1})			
K-40 C	0.1312(23)	0.18(4)	-1.86	-0.95	-35(12)
Co-60 C	0.0610(4)	0.0754(19)	-7.42 Q	-1.87	-19.1(21)
Ba-133 C	0.0430(11)	0.055(3)	-4.17 Q	-1.32	-22(5)
Cs-137 C	0.00097(23)	0.00110(18)	0.32	0.62	1(4) × 10^{1}
Eu-152 C	1.015(4)	1.17(13)	-1.13	-0.73	-13(10)
Eu-154 C	0.0366(7)	0.048(5)	-2.19	-2.08	-23(8)
Ra-226 C	0.050(6)	0.05020(14)	0.02	0.62	0(12)
Ra-228 C	0.0115(9)	0.0102(17)	0.62	0.62	12(21)
Th-228 C	0.0060(3)	–			

Table B41 – Laboratory 59

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.2(9)	16.32(5)	-0.14	-0.19	-1(6)
Zr-95 GH	6.5(4)	6.82(8)	-0.94	-1.32	-5(6)
Nb-95 GH	11.3(7)	11.94(16)	-0.86	-0.94	-5(6)
Sb-125 GH	16.1(9)	17.23(8)	-1.28	-1.61	-7(6)
Ba-133 GH	3.83(22)	4.07(3)	-1.07	-1.31	-6(6)
Cs-134 GH	1.06(6)	1.127(8)	-1.11	-1.35	-6(5)
Cs-137 GH	3.48(20)	3.68(3)	-0.98	-1.38	-5(6)
Ce-144 GH	7.4(5)	7.50(6)	-0.20	-0.24	-1(6)
Eu-152 GH	18.4(11)	18.99(14)	-0.52	-0.62	-3(6)
Eu-155 GH	3.95(23)	3.72(3)	0.97	1.23	6(6)

Table B42 – Laboratory 61

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.1(4)	11.72(4)	-1.67	-0.98	-5(4)
Zr-95 GL	2.8(4)	4.21(5)	-4.33 D	-3.38 D	-33(8)
Cd-109 GL	54(6)	–			
Sb-125 GL	11.8(6)	13.43(7)	-2.84 Q	-1.99	-12(5)
Cs-134 GL	2.77(17)	3.95(3)	-6.85 D	-4.30 D	-30(5)
Cs-137 GL	9.0(4)	8.84(6)	0.26	0.20	1(5)
Ce-144 GL	14.8(17)	14.80(10)	0.00	0.00	0(11)
Eu-152 GL	15.0(5)	17.91(12)	-5.66 D	-2.81 D	-16(3)
Eu-155 GL	4.3(8)	6.18(5)	-2.30	-3.85 Q	-31(13)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	15.5(3)	16.32(5)	-2.69 Q	-1.25	-5.0(19)
Zr-95 GH	5.11(5)	6.82(8)	-18.02 D	-6.32 D	-25.0(11)
Cd-109 GH	5.7(14)	–			
Sb-125 GH	17.20(12)	17.23(8)	-0.30	-0.06	-0.3(9)
Ba-133 GH	4.07(5)	4.07(3)	0.05	0.02	0.1(14)
Cs-134 GH	1.050(10)	1.127(8)	-6.00 Q	-1.55	-6.9(11)
Cs-137 GH	3.78(6)	3.68(3)	1.56	0.72	2.8(18)
Ce-144 GH	7.05(20)	7.50(6)	-2.16	-1.22	-6(3)
Eu-152 GH	17.90(10)	18.99(14)	-6.41 Q	-1.23	-5.7(9)
Eu-155 GH	3.58(10)	3.72(3)	-1.39	-0.79	-4(3)

Table B43 – Laboratory 62

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.9(14)	11.72(4)	0.11	0.23	1(12)
Zr-95 GL	4.0(5)	4.21(5)	-0.37	-0.47	-5(12)
Nb-95 GL	7.2(8)	7.38(10)	-0.26	-0.43	-3(11)
Sb-125 GL	13.6(16)	13.43(7)	0.07	0.13	1(12)
Ba-133 GL	3.6(5)	4.15(3)	-1.31	-2.06	-14(10)
Cs-134 GL	3.3(4)	3.95(3)	-1.64	-2.34	-16(10)
Cs-137 GL	9.0(10)	8.84(6)	0.12	0.22	1(12)
Ce-144 GL	16.4(21)	14.80(10)	0.78	1.52	11(14)
Eu-152 GL	15.7(18)	17.91(12)	-1.24	-2.14	-12(10)
Eu-155 GL	6.9(8)	6.18(5)	0.87	1.41	11(13)

Table B44 – Laboratory 65

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	9.7(7)	9.99(13)	-0.40	-0.40	-3(7)
U-238 AL	3.8(5)	3.72(9)	0.15	0.29	2(12)
Pu-238 AL	17.3(9)	17.13(8)	0.19	0.18	1(5)
Pu-239 AL	19.6(7)	19.59(12)	0.01	0.01	0(4)
Am-241 AL	9.6(8)	10.07(4)	-0.58	-0.82	-5(8)
Cm-244 AL	9.6(9)	13.20(6)	-3.99 D	-4.66 D	-27(7)
gross α AL	94(5)	93(17)	0.06	0.22	1(19)
Co-60 GL	11.5(3)	11.72(4)	-0.71	-0.30	-1.6(23)
Zr-95 GL	4.16(13)	4.21(5)	-0.38	-0.13	-1(4)
Nb-95 GL	4.93(14)	7.38(10)	-14.25 D	-4.73 D	-33.2(21)
Sb-125 GL	13.1(5)	13.43(7)	-0.88	-0.46	-3(4)
Ba-133 GL	4.01(12)	4.15(3)	-1.17	-0.53	-3(3)
Cs-134 GL	3.95(7)	3.95(3)	-0.01	0.00	-0.0(19)
Cs-137 GL	8.96(25)	8.84(6)	0.47	0.22	1(3)
Ce-144 GL	15.0(5)	14.80(10)	0.48	0.22	2(4)
Eu-152 GL	17.3(4)	17.91(12)	-1.49	-0.60	-3.5(23)
Eu-155 GL	6.02(22)	6.18(5)	-0.71	-0.33	-3(4)

Table B45 – Laboratory 66

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	16.1(7)	9.99(13)	8.58 D	8.48 D	61(7)
Np-237 AL	1.59(22)	8.60(9)	-29.44 D	-5.60 D	-82(3)
U-238 AL	2.93(21)	3.72(9)	-3.50 D	-3.39 D	-21(6)
Pu-238 AL	18.5(16)	17.13(8)	0.86	1.45	8(9)
Pu-239 AL	21.1(18)	19.59(12)	0.84	1.50	8(9)
Am-241 AL	19(4)	10.07(4)	2.23	15.83 Q	89(40)
Cm-244 AL	25(5)	13.20(6)	2.36	15.25 Q	89(38)
Ni-63 BL	5.1(9)	8.6(4)	-3.62 D	-3.54 D	-41(11)
Sr-89 BL	16(5)	15.90(10)	0.06	0.11	2(31)
Sr-90 BL	16.3(6)	13.37(3)	4.87 D	2.88 D	22(5)
Tc-99 BL	21.6(25)	16.45(4)	2.06	3.15 Q	31(15)
H-3 HTO B2	18(4)	426(4)	-70.72 D	-14.11 D	-95.8(9)
H-3 total B2	18(4)	637(5)*	-98.13 D	-14.32 D	-97.2(6)
C-14 B2	82(10)	176.4(11)	-9.39 D	-6.42 D	-54(6)
Cl-36 B2	387(46)	402.2(25)	-0.33	-0.55	-4(11)
I-129 B2	396(48)	372(4)	0.50	1.48	7(13)
K-40 GL	2.1(5)	–			
Fe-59 GL	0.7(6)	–			
Co-60 GL	12.40(20)	11.72(4)	3.33 Q	1.07	5.8(17)
Sb-125 GL	10.9(3)	13.43(7)	-8.32 D	-3.08 D	-19.0(23)
Ba-133 GL	3.14(12)	4.15(3)	-8.23 D	-3.71 D	-24(3)
Cs-134 GL	3.90(15)	3.95(3)	-0.33	-0.19	-1(4)
Cs-137 GL	8.50(15)	8.84(6)	-2.08	-0.61	-3.8(18)
Eu-152 GL	17.2(8)	17.91(12)	-0.88	-0.69	-4(5)
Eu-155 GL	3.6(4)	6.18(5)	-7.43 D	-5.20 D	-41(6)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	5.8(6)	2.720(19)	2.67 D	3.94 D	24(9)
Ni-63 BH	1.88(19)	9.8(4)	-18.15 D	-15.99 D	-80.7(21)
Sr-89 BH	15.1(12)	6.67(4)	7.17 D	11.36 D	126(18)
Sr-90 BH	13.88(19)	17.06(3)	-16.57 D	-4.44 D	-18.7(11)
Tc-99 BH	8.9(9)	6.501(15)	2.67 D	5.35 D	37(14)
Ra-226 AH	6.0(5)	4.84(7)	2.67 D	3.94 D	24(9)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Np-237 AH	15.84(22)	16.63(17)	-2.86 Q	-0.64	-4.7(16)
U-238 AH	2.8(4)	2.02(5)	2.29	7.53 Q	37(16)
Pu-238 AH	16.03(21)	16.93(5)	-4.15 Q	-1.02	-5.3(13)
Pu-239 AH	7.45(15)	7.91(4)	-2.96 Q	-1.10	-5.8(20)
Am-241 AH	6.04(25)	3.858(8)	8.72 D	13.55 D	57(7)
Cm-244 AH	27.3(4)	17.23(6)	28.44 D	11.40 D	58.4(21)
K-40 C	0.190(20)	0.18(4)	-0.27	-0.15	-6(20)
Co-58 C	0.013(4)	–			
Co-60 C	0.091(3)	0.0754(19)	4.48 Q	2.07	21(5)
Ba-133 C	0.0765(21)	0.055(3)	6.33 Q	2.36	39(8)
Eu-152 C	1.61(3)	1.17(13)	3.19 Q	2.10	38(16)
Eu-154 C	0.049(4)	0.048(5)	0.22	0.27	3(14)

Table B46 – Laboratory 67

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.6(10)	16.32(5)	0.30	0.44	2(6)
Zr-95 GH	7.0(6)	6.82(8)	0.41	0.83	3(8)
Nb-95 GH	6.9(5)	11.94(16)	-10.01 D	-7.95 D	-42(4)
Sb-125 GH	17.7(12)	17.23(8)	0.42	0.67	3(7)
Ba-133 GH	3.9(3)	4.07(3)	-0.68	-1.09	-5(7)
Cs-134 GH	1.09(13)	1.127(8)	-0.29	-0.75	-3(12)
Cs-137 GH	3.9(3)	3.68(3)	0.63	1.28	5(8)
Ce-144 GH	8.0(11)	7.50(6)	0.48	1.42	7(14)
Eu-152 GH	18.9(12)	18.99(14)	-0.07	-0.09	0(6)
Eu-155 GH	3.8(3)	3.72(3)	0.31	0.52	3(8)

Table B47 – Laboratory 68

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	9.3(7)	9.99(13)	-0.96	-0.95	-7(7)
Co-60 GL	10.9(6)	11.72(4)	-1.37	-1.29	-7(5)
Zr-95 GL	6.0(9)	4.21(5)	1.94	4.30 Q	42(22)
Sb-125 GL	13.4(12)	13.43(7)	-0.03	-0.04	0(9)
Ba-133 GL	4.3(4)	4.15(3)	0.37	0.53	4(9)
Cs-134 GL	3.9(4)	3.95(3)	-0.03	-0.04	0(8)
Cs-137 GL	9.0(6)	8.84(6)	0.29	0.33	2(7)
Ce-144 GL	14.8(22)	14.80(10)	0.02	0.04	0(15)
Eu-152 GL	15.5(10)	17.91(12)	-2.34	-2.30	-13(6)
Eu-155 GL	5.6(6)	6.18(5)	-0.96	-1.10	-9(9)
	(Bq g^{-1})	(Bq g^{-1})			
Co-58 GH	0.170(20)	–			
Co-60 GH	14.9(6)	16.32(5)	-2.35	-2.16	-9(4)
Zn-65 GH	0.280(20)	–			
Zr-95 GH	6.810(20)	6.82(8)	-0.08	-0.03	-0.1(12)
Sb-125 GH	17.0(7)	17.23(8)	-0.41	-0.38	-2(4)
Ba-133 GH	3.90(15)	4.07(3)	-1.09	-0.92	-4(4)
Cs-134 GH	1.02(4)	1.127(8)	-2.63 Q	-2.15	-10(4)
Cs-137 GH	3.65(14)	3.68(3)	-0.19	-0.19	-1(4)
Ce-144 GH	7.3(3)	7.50(6)	-0.65	-0.54	-3(4)
Eu-152 GH	17.8(6)	18.99(14)	-1.93	-1.35	-6(4)
Eu-155 GH	4.13(17)	3.72(3)	2.35	2.22	11(5)

Table B48 – Laboratory 69

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	5.4(4)	4.84(7)	1.38	1.90	12(8)

Table B49 – Laboratory 71

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
U-238 AL	3.37(19)	3.72(9)	-1.70	-1.51	-9(6)
Pu-238 AL	16.7(4)	17.13(8)	-1.07	-0.46	-2.5(24)
Pu-239 AL	19.1(5)	19.59(12)	-0.96	-0.45	-2.3(24)
Am-241 AL	10.8(3)	10.07(4)	2.51	1.21	7(3)
Cm-244 AL	8.80(21)	13.20(6)	-20.17 D	-5.69 D	-33.3(16)

Table B50 – Laboratory 72

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 HTO B2	62(6) × 10^{1}	426(4)	3.23 D	6.71 D	46(14)
H-3 total B2	62(6) × 10^{1}	637(5)*	-0.29	-0.40	-3(9)
Co-60 GL	11.7(7)	11.72(4)	-0.09	-0.10	-1(6)
Zr-95 GL	4.9(4)	4.21(5)	1.80	1.53	15(9)
Nb-95 GL	12.3(8)	7.38(10)	6.13 D	9.53 D	67(11)
Sb-125 GL	14.0(9)	13.43(7)	0.66	0.71	4(7)
Ba-133 GL	3.88(25)	4.15(3)	-1.09	-1.00	-7(6)
Cs-134 GL	3.65(23)	3.95(3)	-1.30	-1.10	-8(6)
Cs-137 GL	9.2(6)	8.84(6)	0.58	0.64	4(7)
Ce-144 GL	14.4(11)	14.80(10)	-0.41	-0.43	-3(8)
Eu-152 GL	16.0(10)	17.91(12)	-1.95	-1.89	-11(6)
Eu-155 GL	5.0(4)	6.18(5)	-3.13 Q	-2.51	-20(7)

Table B51 – Laboratory 73

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Ra-226 AL	9.9(5)	9.99(13)	-0.12	-0.08	-1(5)
U-238 AL	3.56(25)	3.72(9)	-0.62	-0.70	-4(7)
Pu-238 AL	17.0(9)	17.13(8)	-0.14	-0.13	-1(6)
Pu-239 AL	19.6(10)	19.59(12)	0.01	0.01	0(5)
Am-241 AL	10.7(6)	10.07(4)	1.06	1.13	6(6)
Cm-244 AL	11.4(6)	13.20(6)	-2.99 Q	-2.33	-14(5)
Ni-63 BL	10.9(5)	8.6(4)	4.22 Q	2.39	27(7)
Sr-89 BL	15.4(6)	15.90(10)	3.27 Q	2.00	15(5)
Sr-90 BL	12.7(8)	13.37(3)	-0.83	-0.65	-5(6)
Co-60 GL	11.8(8)	11.72(4)	0.10	0.12	1(7)
Zr-95 GL	4.4(5)	4.21(5)	0.37	0.45	4(12)
Nb-95 GL	9.8(11)	7.38(10)	2.19	4.67 Q	33(15)
Sb-125 GL	14.0(15)	13.43(7)	0.36	0.66	4(12)
Ba-133 GL	4.2(4)	4.15(3)	0.11	0.17	1(10)
Cs-134 GL	3.9(4)	3.95(3)	-0.13	-0.19	-1(10)
Cs-137 GL	9.0(6)	8.84(6)	0.27	0.29	2(7)
Ce-144 GL	15.0(17)	14.80(10)	0.12	0.19	1(12)
Eu-152 GL	18.5(21)	17.91(12)	0.28	0.56	3(12)
Eu-155 GL	6.4(7)	6.18(5)	0.31	0.45	4(11)
	(Bq g^{-1})	(Bq g^{-1})			
Ra-226 AH	4.94(20)	4.84(7)	0.47	0.34	2(5)
U-238 AH	1.84(13)	2.02(5)	-1.30	-1.82	-9(7)
Pu-238 AH	15.4(8)	16.93(5)	-1.90	-1.74	-9(5)
Pu-239 AH	7.2(4)	7.91(4)	-1.94	-1.76	-9(5)
Am-241 AH	3.86(20)	3.858(8)	0.01	0.01	0(5)
Cm-244 AH	15.6(8)	17.23(6)	-2.03	-1.84	-9(5)
Ni-63 BH	10.1(4)	9.8(4)	0.67	0.77	4(6)
Sr-90 BH	19.3(7)	17.06(3)	3.19 D	3.12 D	13(4)
Sr-90 BH	17.9(7)	17.06(3)	1.21	1.15	5(4)
Co-60 GH	16.3(8)	16.32(5)	-0.02	-0.03	0(5)
Zr-95 GH	6.8(3)	6.82(8)	-0.05	-0.06	0(5)
Nb-95 GH	15.0(8)	11.94(16)	3.75 D	4.80 D	26(7)

continues

continued					
	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
Sb-125 GH	17.5(8)	17.23(8)	0.32	0.35	1(5)
Ba-133 GH	4.20(20)	4.07(3)	0.66	0.73	3(5)
Cs-134 GH	1.14(6)	1.127(8)	0.21	0.26	1(6)
Cs-137 GH	3.70(20)	3.68(3)	0.11	0.16	1(6)
Ce-144 GH	7.5(4)	7.50(6)	0.00	0.01	0(6)
Eu-152 GH	18.3(9)	18.99(14)	-0.75	-0.78	-4(5)
Eu-155 GH	3.80(20)	3.72(3)	0.37	0.41	2(6)

Table B52 – Laboratory 74

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
U-238 AH	1.45(5)	2.02(5)	-8.61 D	-5.78 D	-28(3)
H-3 BH	2.51(6)	2.720(19)	-3.66 Q	-1.58	-7.7(21)
Fe-55 BH	4.99(21)	5.55(10)	-2.38	-1.31	-10(4)
Ni-63 BH	10.5(4)	9.8(4)	1.36	1.50	8(6)
Sr-90 BH	16.5(5)	17.06(3)	-1.08	-0.75	-3(3)
Tc-99 BH	5.91(17)	6.501(15)	-3.42 Q	-1.32	-9(3)
Co-60 GH	15.1(6)	16.32(5)	-2.05	-1.85	-7(4)
Cs-134 GH	0.94(4)	1.127(8)	-4.93 D	-3.75 D	-17(4)
Cs-137 GH	3.59(14)	3.68(3)	-0.61	-0.61	-2(4)
H-3 total C	5.8(4)	8.9(15)	-1.96	-0.84	-34(12)

Table B53 – Laboratory 75

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
U-238 AL	3.7(3)	3.72(9)	-0.04	-0.06	0(9)
Pu-238 AL	17.3(17)	17.13(8)	0.10	0.18	1(10)
Pu-239 AL	19.3(11)	19.59(12)	-0.27	-0.29	-1(6)
Am-241 AL	10.2(5)	10.07(4)	0.27	0.24	1(5)
Cm-244 AL	13.0(8)	13.20(6)	-0.25	-0.26	-2(6)
H-3 BL	8.8(6)	8.11(6)	1.07	0.64	8(7)
Sr-90 BL	12.8(6)	13.37(3)	-0.98	-0.58	-4(5)
C-14 B2	79(13)	176.4(11)	-7.47 D	-6.63 D	-55(8)
Co-60 GL	11.8(23) Q	11.72(4)	0.03	0.12	1(20)
Zr-95 GL	3.9(4)	4.21(5)	-0.75	-0.71	-7(9)
Nb-95 GL	10.7(3)	7.38(10)	10.49 D	6.40 D	45(5)
Sb-125 GL	13.8(7)	13.43(7)	0.50	0.42	3(5)
Ba-133 GL	3.60(13)	4.15(3)	-4.17 Q	-2.03	-13(4)
Cs-134 GL	3.69(15)	3.95(3)	-1.71	-0.95	-7(4)
Cs-137 GL	8.74(17)	8.84(6)	-0.54	-0.18	-1.1(20)
Ce-144 GL	15.4(5)	14.80(10)	1.17	0.57	4(4)
Eu-152 GL	17.3(9)	17.91(12)	-0.68	-0.59	-3(5)
Eu-155 GL	6.50(23)	6.18(5)	1.36	0.65	5(4)

Table B54 – Laboratory 76

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Sr-90 BL	11.5(12)	13.37(3)	-1.59	-1.80	-14(9)
Tc-99 BL	4.6(5)	16.45(4)	-25.61 D	-7.24 D	-72(3)
Co-60 GL	11.8(13)	11.72(4)	0.06	0.12	1(11)
Zr-95 GL	4.2(12)	4.21(5)	-0.05	-0.13	-1(28)
Nb-95 GL	14.1(20)	7.38(10)	3.32 D	12.89 D	90(27)
Sb-125 GL	13.7(12)	13.43(7)	0.16	0.24	1(9)
Ba-133 GL	3.9(7)	4.15(3)	-0.40	-1.00	-7(17)
Cs-134 GL	3.9(6)	3.95(3)	-0.05	-0.11	-1(15)
Cs-137 GL	9.4(11)	8.84(6)	0.50	1.00	6(13)
Eu-152 GL	17.5(12)	17.91(12)	-0.36	-0.40	-2(7)
Eu-155 GL	6.1(11)	6.18(5)	-0.08	-0.16	-1(17)

Table B55 – Laboratory 77

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.6(10)	16.32(5)	0.28	0.43	2(6)
Zr-95 GH	6.6(4)	6.82(8)	-0.51	-0.80	-3(6)
Nb-95 GH	12.6(9)	11.94(16)	0.76	1.03	5(7)
Sb-125 GH	16.2(10)	17.23(8)	-1.05	-1.42	-6(6)
Ba-133 GH	3.53(21)	4.07(3)	-2.53	-2.96 Q	-13(5)
Cs-134 GH	1.06(6)	1.127(8)	-1.11	-1.35	-6(6)
Cs-137 GH	3.68(22)	3.68(3)	0.01	0.02	0(6)
Ce-144 GH	7.2(5)	7.50(6)	-0.60	-0.73	-4(6)
Eu-152 GH	18.9(12)	18.99(14)	-0.07	-0.10	0(6)
Eu-155 GH	3.66(22)	3.72(3)	-0.29	-0.35	-2(6)

Table B56 – Laboratory 78

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	2.67(4)	2.720(19)	-1.36	-0.39	-1.9(14)
Fe-55 BH	4.95(9)	5.55(10)	-4.53 Q	-1.41	-11(22)
Ni-63 BH	12.8(7)	9.8(4)	4.07 D	6.19 D	31(8)
Sr-89 BH	12.1(15)	6.67(4)	3.68 D	7.30 D	81(22)
Sr-90 BH	14.26(22)	17.06(3)	-12.68 D	-3.91 D	-16.4(13)
gross β BH	37.0(13)	41(4)	-0.96	-1.86	-9(9)

Table B57 – Laboratory 79

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.5(3)	16.32(5)	0.58	0.28	1.1(19)
Zr-95 GH	6.47(15)	6.82(8)	-2.04	-1.28	-5.1(25)
Nb-95 GH	11.73(22)	11.94(16)	-0.78	-0.33	-1.8(23)
Sb-125 GH	16.9(4)	17.23(8)	-0.88	-0.47	-2.0(23)
Ba-133 GH	3.89(11)	4.07(3)	-1.56	-0.98	-4(3)
Cs-134 GH	1.00(12)	1.127(8)	-1.06	-2.55	-11(11)
Cs-137 GH	3.48(7)	3.68(3)	-2.61 Q	-1.38	-5.4(20)
Ce-144 GH	7.50(18)	7.50(6)	0.01	0.01	0.0(25)
Eu-152 GH	18.0(4)	18.99(14)	-2.51	-1.10	-5.1(20)
Eu-155 GH	3.55(11)	3.72(3)	-1.54	-0.95	-5(3)

Table B58 – Laboratory 80

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	17.2(3)	16.32(5)	2.93 Q	1.36	5.5(19)
Zr-95 GH	7.23(12)	6.82(8)	2.86 Q	1.53	6.1(22)
Nb-95 GH	12.9(3)	11.94(16)	2.95 Q	1.45	8(3)
Sb-125 GH	18.0(6)	17.23(8)	1.21	1.01	4(4)
Ba-133 GH	4.22(7)	4.07(3)	2.03	0.84	3.8(19)
Cs-134 GH	1.17(3)	1.127(8)	1.38	0.86	4(3)
Cs-137 GH	3.88(6)	3.68(3)	3.07 Q	1.42	5.5(18)
Ce-144 GH	7.32(19)	7.50(6)	-0.90	-0.48	-2(3)
Eu-152 GH	19.8(4)	18.99(14)	1.98	0.97	4.5(23)
Eu-155 GH	3.82(11)	3.72(3)	0.84	0.52	3(3)

Table B59 – Laboratory 81

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
H-3 HTO B2	$62(5) \times 10^1$	426(4)	3.77 D	6.68 D	45(12)
H-3 total B2	$62(5) \times 10^1$	637(5)	-0.36	-0.42	-3(8)
Co-60 GL	11.6(5)	11.72(4)	-0.24	-0.19	-1(5)
Zr-95 GL	4.0(2)	4.21(5)	-1.03	-0.51	-5(5)
Nb-95 GL	7.6(4)	7.38(10)	0.53	0.42	3(6)
Sb-125 GL	13.0(6)	13.43(7)	-0.75	-0.55	-3(5)
Ba-133 GL	3.6(2)	4.15(3)	-2.75 Q	-2.03	-13(5)
Cs-134 GL	3.7(2)	3.95(3)	-1.24	-0.92	-6(5)
Cs-137 GL	8.8(4)	8.84(6)	-0.09	-0.07	0(5)
Ce-144 GL	15.1(7)	14.80(10)	0.42	0.28	2(5)
Eu-152 GL	16.7(7)	17.91(12)	-1.71	-1.17	-7(4)
Eu-155 GL	6.7(3)	6.18(5)	1.71	1.06	8(5)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 C	0.068(5)	0.0754(19)	-1.38	-0.96	-10(7)
Ba-133 C	0.046(3)	0.055(3)	-2.25	-0.99	-16(7)
Eu-152 C	0.98(7)	1.17(13)	-1.23	-0.89	-16(11)
Eu-154 C	0.035(3)	0.048(5)	-2.17	-2.38	-26(10)

Table B60 – Laboratory 82

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.2(11)	11.72(4)	-0.47	-0.82	-4(9)
Zr-95 GL	4.5(9)	4.21(5)	0.29	0.59	6(20)
Nb-95 GL	12(4)	7.38(10)	1.25	7.95 Q	56(45)
Sb-125 GL	13.1(15)	13.43(7)	-0.24	-0.43	-3(11)
Ba-133 GL	4.5(5)	4.15(3)	0.68	1.30	9(13)
Cs-134 GL	4.5(5)	3.95(3)	1.23	2.11	15(12)
Cs-137 GL	8.8(9)	8.84(6)	-0.02	-0.03	0(11)
Ce-144 GL	15.0(22)	14.80(10)	0.09	0.19	1(15)
Eu-152 GL	18.7(20)	17.91(12)	0.39	0.76	4(11)
Eu-155 GL	5.6(9)	6.18(5)	-0.63	-1.14	-9(14)
	(Bq g^{-1})	(Bq g^{-1})			
Na-22 GH	1.06(16)	–			
Cr-51 GH	3.7(5)	–			
Co-60 GH	16.0(16)	16.32(5)	-0.20	-0.48	-2(10)
Zr-95 GH	6.8(7)	6.82(8)	-0.01	-0.03	0(10)
Nb-95 GH	13(4) Q	11.94(16)	0.27	1.50	8(29)
Sb-125 GH	17.5(18)	17.23(8)	0.14	0.35	1(10)
Ba-133 GH	4.0(5)	4.07(3)	-0.23	-0.54	-2(11)
Cs-134 GH	1.20(12)	1.127(8)	0.60	1.46	6(11)
Cs-137 GH	3.3(4)	3.68(3)	-1.02	-2.36	-9(9)
Ce-144 GH	7.8(8)	7.50(6)	0.37	0.79	4(10)
Eu-152 GH	18.8(19)	18.99(14)	-0.10	-0.21	-1(10)
Eu-155 GH	3.2(4)	3.72(3)	-1.61	-2.92 Q	-14(9)

Table B61 – Laboratory 83

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Cs-137 GL	9.6(6)	8.84(6)	1.26	1.38	9(7)
	(Bq g^{-1})	(Bq g^{-1})			
Cs-137 GH	4.00(20)	3.68(3)	1.60	2.26	9(6)

Table B62 – Laboratory 84

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	10.89(21)	11.72(4)	-3.91 Q	-1.31	-7.1(18)
Zr-95 GL	3.58(19)	4.21(5)	-3.22 Q	-1.52	-15(5)
Nb-95 GL	9(5)	7.38(10)	0.32	3.12 Q	22(68)
Sb-125 GL	12.5(4)	13.43(7)	-2.36	-1.15	-7(3)
Ba-133 GL	3.86(10)	4.15(3)	-2.83 Q	-1.08	-7.1(25)
Cs-134 GL	3.66(9)	3.95(3)	-3.09 Q	-1.06	-7.4(24)
Cs-137 GL	8.36(23)	8.84(6)	-2.01	-0.87	-5(3)
Ce-144 GL	13.3(4)	14.80(10)	-3.63 Q	-1.42	-10(3)
Eu-152 GL	15.9(6)	17.91(12)	-3.29 Q	-1.94	-11(4)
Eu-155 GL	5.8(3)	6.18(5)	-1.25	-0.78	-6(5)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 C	0.0659(15)	0.0754(19)	-3.90 Q	-1.23	-13(3)
Ba-133 C	0.0455(22)	0.055(3)	-2.76	-1.05	-17(6)
Eu-152 C	1.03(6)	1.17(13)	-0.93	-0.65	-12(11)
Eu-154 C	0.041(4)	0.048(5)	-1.03	-1.24	-14(12)
Pb-210 C	0.60(3)	–			

Table B63 – Laboratory 85

	Result	Assigned result	Zeta score	z-score	Deviation (%)
	(Bq g^{-1})	(Bq g^{-1})			
H-3 BH	2.85(0)	2.720(19)	6.80 Q	0.98	4.8(8)
gross β BH	45.92(0)	41(4)	1.36	2.51	13(10)
Co-60 GH	17.2(5)	16.32(5)	1.65	1.31	5(4)
Zr-95 GH	8.0(3)	6.82(8)	3.78 D	4.34 D	17(5)
Sb-125 GH	20.5(10)	17.23(8)	3.28	4.42	19(6)
Ba-133 GH	4.7(4)	4.07(3)	1.77	3.44	15(9)
Cs-134 GH	1.19(5)	1.127(8)	1.24	1.26	6(5)
Cs-137 GH	4.39(16)	3.68(3)	4.39 D	5.00 D	19(5)
Ce-144 GH	9.1(8)	7.50(6)	1.86	4.24 Q	21(11)
Eu-152 GH	18.9(11)	18.99(14)	-0.08	-0.10	0(6)
Co-60 C	0.075(4)	0.0754(19)	-0.12	-0.07	-1(6)
Ba-133 C	0.062(4)	0.055(3)	1.54	0.80	13(9)
Eu-152 C	1.39(14)	1.17(13)	1.17	1.08	19(18)
Eu-154 C	0.050(6)	0.048(5)	0.35	0.52	6(17)
Ra-226 C	0.05(6)	0.05020(14)	0.00	-0.62	$0(11) \times 10^1$

Table B64 – Laboratory 86

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
K-40 GL	4.6(4)	–			
Co-60 GL	10.8(8)	11.72(4)	-1.16	-1.40	-8(7)
Zr-95 GL	3.6(3)	4.21(5)	-2.50	-1.60	-16(6)
Nb-95 GL	11.1(8)	7.38(10)	4.66 D	7.16 D	50(11)
Sb-125 GL	12.8(9)	13.43(7)	-0.75	-0.83	-5(7)
Ba-133 GL	3.6(3)	4.15(3)	-2.23	-2.14	-14(6)
Cs-134 GL	3.23(23)	3.95(3)	-3.11 D	-2.63 D	-18(6)
Cs-137 GL	8.7(6)	8.84(6)	-0.29	-0.32	-2(7)
Ce-144 GL	14.8(11)	14.80(10)	0.00	0.00	0(8)
Eu-152 GL	16.0(12)	17.91(12)	-1.67	-1.87	-11(7)
Eu-155 GL	6.4(6)	6.18(5)	0.37	0.43	3(9)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	16.4(12)	16.32(5)	0.04	0.08	0(7)
Zr-95 GH	9.1(7)	6.82(8)	3.46 D	8.37 D	33(10)
Nb-95 GH	6.2(5)	11.94(16)	-12.35 D	-9.08 D	-48(4)
Sb-125 GH	17.5(12)	17.23(8)	0.24	0.40	2(7)
Ba-133 GH	3.9(3)	4.07(3)	-0.66	-1.03	-5(8)
Cs-134 GH	1.03(7)	1.127(8)	-1.38	-1.95	-9(6)
Cs-137 GH	3.9(3)	3.68(3)	0.67	1.28	5(8)
Ce-144 GH	7.5(6)	7.50(6)	-0.09	-0.13	-1(7)
Eu-152 GH	17.8(12)	18.99(14)	-0.92	-1.30	-6(7)
Eu-155 GH	3.8(4)	3.72(3)	0.22	0.41	2(9)
K-40 C	0.35(3)	0.18(4)	3.25	2.01	7(4) × 10^1
Co-60 C	0.084(6)	0.0754(19)	1.34	1.10	11(9)
Ba-133 C	0.064(5)	0.055(3)	1.59	0.93	15(10)
Eu-152 C	1.38(10)	1.17(13)	1.28	1.02	18(16)
Eu-154 C	0.051(4)	0.048(5)	0.54	0.65	7(14)

Table B65 – Laboratory 87

	Result	Assigned result	Zeta score	*z*-score	Deviation (%)
	(Bq kg^{-1})	(Bq kg^{-1})			
Co-60 GL	11.6(3)	11.72(4)	-0.47	-0.22	-1(3)
Zr-95 GL	5.6(6)	4.21(5)	2.34	3.33 Q	33(14)
Nb-95 GL	23.1(12)	7.38(10)	12.84 D	30.33 D	213(17)
Sb-125 GL	13.2(8)	13.43(7)	-0.26	-0.26	-2(6)
Ba-133 GL	4.04(20)	4.15(3)	-0.57	-0.42	-3(5)
Cs-134 GL	4.18(24)	3.95(3)	0.95	0.83	6(6)
Cs-137 GL	8.87(22)	8.84(6)	0.14	0.06	0(3)
Ce-144 GL	17.1(11)	14.80(10)	2.11	2.15	15(7)
Eu-152 GL	17.5(7)	17.91(12)	-0.68	-0.43	-2(4)
Eu-155 GL	6.7(5)	6.18(5)	1.17	1.10	9(8)
	(Bq g^{-1})	(Bq g^{-1})			
Co-60 GH	15.49(18)	16.32(5)	-4.42 Q	-1.26	-5.1(11)
Zr-95 GH	8.00(24)	6.82(8)	4.67 D	4.38 D	17(4)
Nb-95 GH	36.1(7)	11.94(16)	34.57 D	37.91 D	202(7)
Sb-125 GH	17.2(5)	17.23(8)	-0.07	-0.05	0(3)
Ba-133 GH	4.05(18)	4.07(3)	-0.09	-0.09	0(5)
Cs-134 GH	0.97(4)	1.127(8)	-3.85 D	-3.15 D	-14(4)
Cs-137 GH	3.43(6)	3.68(3)	-3.73 Q	-1.73	-6.7(18)
Ce-144 GH	7.4(3)	7.50(6)	-0.22	-0.18	-1(4)
Eu-152 GH	18.3(4)	18.99(14)	-1.66	-0.81	-3.8(23)
Eu-155 GH	3.65(17)	3.72(3)	-0.43	-0.41	-2(5)

Appendix C. Source preparation

C1 AL samples

A mixed radionuclide solution (B07012) was prepared by mixing standardised solutions of the individual nuclides (Table C1). The chemical form of the AL samples was 2 M HNO_3.

Table C1 – Starting material B07012

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor AL GDF1	B07012 Act. conc. (kBq g^{-1})
^{226}Ra	A05520	10.60(14)	103.49(3)	0.1024(13)
^{237}Np	A00130	9.11(9)	103.31(10)	0.0882(9)
^{238}U	A00275 and A00276	0.1015(23)	2.65916(17)	0.0382(9)
^{238}Pu	A05611	17.46(5)	99.46(6)	0.1756(6)
^{239}Pu	A06813	19.89(10)	99.56(7)	0.1998(10)
^{240}Pu*	A06813	0.087	99.56(7)	0.00088
^{241}Pu*	A06813	0.12	99.56(7)	0.0012
^{241}Am	A06181	10.031(18)	97.197(20)	0.10320(19)
^{244}Cm	A98798	14.39(5)	106.28(3)	0.1354(4)
^{240}Pu*	A98798	0.026	106.28(3)	0.00024

The B07012 solution was diluted two times to produce the AL sample in B07035 (Table C2). All dilutions were validated using liquid scintillation counting counting. In total, 15.307 kg of AL sample was produced.

Table C2 – Preparation of solution for AL source B07035

Nuclide	Gravimetric Dilution Factor AL GDF2	Gravimetric Dilution Factor AL GDF3	B07035 Act. conc. (Bq kg^{-1})
^{226}Ra	100.14(17)	102.4(3)	9.99(13)
^{237}Np	100.14(17)	102.4(3)	8.60(9)
^{238}U	100.14(17)	102.4(3)	3.72(9)
^{238}Pu	100.14(17)	102.4(3)	17.13(8)
^{239}Pu	100.14(17)	102.4(3)	19.48(12)
^{240}Pu*	100.14(17)	102.4(3)	0.11
^{241}Pu*	100.14(17)	102.4(3)	0.12
^{241}Am	100.14(17)	102.4(3)	10.07(4)
^{244}Cm	100.14(17)	102.4(3)	13.20(6)
gross alpha	–	–	93(17)

The gross alpha activity concentration was calculated by combining of the activity concentrations of all the nuclides listed above (except ^{241}Pu) plus a ^{210}Po contribution (estimated as 30% of the ^{226}Ra activity concentration, which based on the time elapsed since the last purification of the ^{226}Ra starting material) and the ^{222}Rn, ^{218}Po and ^{214}Po contributions (each estimated as 25% of the ^{226}Ra activity concentration, which is based on the solubility of ^{222}Rn in aqueous solutions at 20 °C). The gross alpha activity concentration uncertainty is dominated by the uncertainty of the ^{222}Rn, ^{218}Po, ^{214}Po and ^{210}Po activity concentrations.

C2 AH samples

A mixed radionuclide solution (B07011) was prepared by mixing standardised solutions of the individual nuclides (Table C3). The chemical form of the AH samples was 2 M HNO_3.

Table C3 – Starting material B07011

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor AH GDF1	B07011 Act. conc. (kBq g^{-1})
^{226}Ra	A05520	10.60(14)	87.58(7)	0.1210(16)
^{237}Np	A00130	9.11(9)	21.919(3)	0.416(4)
^{238}U	A00275 and A00276	0.1015(23)	2.01141(13)	0.0505(11)
^{238}Pu	A05611	17.46(5)	41.277(9)	0.4231(13)
^{239}Pu	A06813	19.89(10)	101.452(16)	0.1960(10)
^{240}Pu*	A06813	0.087	101.452(16)	0.00086
^{241}Pu*	A06813	0.12	101.452(16)	0.0012
^{241}Am	A06181	10.031(18)	104.02(8)	0.09643(19)
^{244}Cm	A98798	14.39(5)	33.408(10)	0.4307(13)
^{240}Pu*	A98798	0.026	33.408(10)	0.00078

The B07011 solution was diluted once to produce the AH sample in B07013 (Table C4). The dilution was validated using liquid scintillation counting. In total, 0.435 kg of AH sample was produced.

Table C4 – Preparation of solution for AH source B07013

Nuclide	Gravimetric Dilution Factor ABH GDF2	B07013 Act. conc. (Bq g^{-1})
^{226}Ra	24.994(25)	4.84(7)
^{237}Np	24.994(25)	16.63(17)
^{238}U	24.994(25)	2.02(5)
^{238}Pu	24.994(25)	16.93(5)
^{239}Pu	24.994(25)	7.84(4)
^{240}Pu*	24.994(25)	0.066
^{241}Pu*	24.994(25)	0.046
^{241}Am	24.994(25)	3.858(8)
^{244}Cm	24.994(25)	17.23(5)
gross alpha	–	75(8)

The gross alpha activity concentration was calculated by combining of the activity concentrations of all the nuclides listed above (except ^{241}Pu) plus a ^{210}Po contribution (estimated as 30% of the ^{226}Ra activity concentration, which based on the time elapsed since the last purification of the ^{226}Ra starting material) and the ^{222}Rn, ^{218}Po and ^{214}Po contributions (each estimated as 25% of the ^{226}Ra activity concentration, which is based on the solubility of ^{222}Rn in aqueous solutions at 20 °C). The gross alpha activity concentration uncertainty is dominated by the uncertainty of the ^{222}Rn, ^{218}Po, ^{214}Po and ^{210}Po activity concentrations.

C3 BL samples

A mixed radionuclide solution (B07196) was prepared by mixing standardised solutions of the individual nuclides (Table C5). The chemical form of the BL samples was 0.1 M HCl (containing 0.0075 mg g^{-1} Fe, 0.0075 mg g^{-1} Ni and 0.0075 mg g^{-1} Sr).

Table C5 – Starting material B07196

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor BL GDF1	B07196 Act. conc. (kBq g^{-1})
^{3}H	A06152	1.531(11)	4.1443(6)	0.369(3)
^{55}Fe	A05609	45.1(8)	95.42(14)	0.472(8)
^{63}Ni	A06805	39.1(16)	100.47(10)	0.389(16)
^{89}Sr	A06864	7.38(5)	10.2349(16)	0.721(5)
^{90}Sr	A05610	38.97(6)	64.28(11)	0.6062(14)
^{99}Tc	A05975	18.33(4)	24.574(9)	0.7459(16)

The B07196 solution was diluted three times to produce the BL sample in B07209 (Table C6). All dilutions were validated using Cerenkov counting. In total, 15.519 kg of BL sample was produced.

Table C6 – Preparation of solution for BL source B07209

Nuclide	Gravimetric Dilution Factor BL GDF2	Gravimetric Dilution Factor BL GDF3	Gravimetric Dilution Factor BL GDF4	B07209 Act. conc. (Bq kg^{-1})
^{3}H	35.635(11)	35.28(3)	36.226(11)	8.11(6)
^{55}Fe	35.609(11)	35.18(3)	36.190(11)	10.42(18)
^{63}Ni	35.609(11)	35.18(3)	36.190(11)	8.6(4)
^{89}Sr	35.609(11)	35.18(3)	36.190(11)	15.90(10)
^{90}Sr	35.609(11)	35.18(3)	36.190(11)	13.37(3)
^{99}Tc	35.609(11)	35.18(3)	36.190(11)	16.45(4)
gross beta	–	–	–	43(10)

The gross beta activity concentration was calculated by combining of the activity concentrations of ^{89}Sr and ^{90}Sr plus the ^{90}Y contribution (estimated as 100% of the ^{90}Sr activity concentration). The beta-max energy of ^{99}Tc is (just) below 0.3 MeV (and is therefore not covered by ISO method 9697:1992) and, consequently, was not included in the calculation of the gross beta activity concentration. However, the ^{99}Tc activity concentration was included in the uncertainty calculation of the gross beta activity concentration (and is by far the dominant component).

C4 BH samples

A mixed radionuclide solution (B07195) was prepared by mixing standardised solutions of the individual nuclides (Table C7). The chemical form of the BL samples was 0.1 M HCl (containing 0.0075 mg g^{-1} Fe, 0.0075 mg g^{-1} Ni and 0.0075 mg g^{-1} Sr).

Table C7 – Starting material B07195

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor BH GDF1	B07195 Act. conc. (kBq g^{-1})
^{3}H	A06152	1.531(11)	7.0411(11)	0.2175(15)
^{55}Fe	A05609	45.1(8)	101.93(5)	0.442(8)
^{63}Ni	A06805	39.1(16)	50.24(3)	0.78(3)
^{89}Sr	A06864	7.38(5)	13.864(3)	0.532(4)
^{90}Sr	A05610	38.97(6)	28.638(7)	1.3607(21)
^{99}Tc	A05975	18.33(4)	35.361(16)	0.5184(11)

The B07195 solution was diluted once to produce the BH sample in B07269 (Table C8). The dilution was validated using Cerenkov counting. In total, 2.243 kg of BH sample was produced.

Table C8 – Preparation of solution for BH source B07269

Nuclide	Gravimetric Dilution Factor ABH GDF2	B07254 Act. conc. (Bq g^{-1})
^{3}H	79.96(7)	2.720(19)
^{55}Fe	79.74(7)	5.55(10)
^{63}Ni	79.74(7)	9.8(4)
^{89}Sr	79.74(7)	6.67(4)
^{90}Sr	79.74(7)	17.06(3)
^{99}Tc	79.74(7)	6.501(15)
gross beta	–	41(4)

The gross beta activity concentration was calculated by combining of the activity concentrations of ^{89}Sr and ^{90}Sr plus the ^{90}Y contribution (estimated as 100% of the ^{90}Sr activity concentration). The maximum beta energy of ^{99}Tc is (just) below 0.3 MeV (and is therefore not covered by ISO method 9697:1992) and, consequently, was not included in the calculation of the gross beta activity concentration. However, the ^{99}Tc activity concentration was included in the uncertainty calculation of the gross beta activity concentration (and is by far the dominant component).

C5 B2 samples

A mixed radionuclide solution (B07238) was prepared by mixing standardised solutions of the individual nuclides (Table C9). The chemical form of the B2 samples was 0.005 M HEPES buffer (pH 8.0) containing 0.010 mg g^{-1} C as carbonate, 0.010 mg g^{-1} Cl as chloride and 0.050 mg g^{-1} I as iodide.

Table C9 – Starting material B07238

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor GDF1	B07238 Act. conc. (kBq g^{-1})
^{3}H (HTO)	A06153	1.531(11)	2.9967(4)	0.511(4)
^{3}H (OBT)	A051189	0.927(11)	3.5878(5)	0.269(4)
^{3}H (HTO)	A051189	0.037(13)	3.5878(5)	0.010(4)
^{14}C	A01147	1.899(11)	8.7967(14)	0.2158(13)
^{36}Cl	A03464	41.37(23)	84.08(24)	0.492(3)
^{129}I	A06015	19.69(20)	43.30(4)	0.455(5)

The solution in B07238 was diluted twice to produce the B2 sample in B07240 (Table C10). The dilutions were validated using liquid scintillation counting. In total, 14.023 kg of B2 sample was produced.

Table C10 – Preparation of solution for B2 source B07240

Nuclide	Gravimetric Dilution Factor B2 GDF2	Gravimetric Dilution Factor B2 GDF3	B07240 Act. conc. (Bq kg^{-1})
^{3}H (HTO)	35.072(12)	34.887(9)	426(4)
^{3}H (OBT)	35.072(12)	34.887(9)	211(3)
^{14}C	35.072(12)	34.887(9)	176.4(11)
^{36}Cl	35.072(12)	34.887(9)	402.2(25)
^{129}I	35.072(12)	34.887(9)	372(4)

C6 GL samples

A mixed radionuclide solution (B07073) was prepared by mixing and diluting standardised solutions of the individual nuclides (Table C11). The chemical form of the GL samples was 2 M HCl containing 0.051 mg g^{-1} Ba, 0.045 mg g^{-1} Co, 0.038 mg g^{-1} Cs, 0.055 mg g^{-1} Eu, 0.050 mg g^{-1} Sb and 0.032 mg g^{-1} Zr. The dilutions were validated using gamma-ray spectrometry.

Table C11 – Starting material B07073

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor GL GDF1	B07073 Act. conc. (kBq g^{-1})
^{60}Co	A06811	196.3(6)	76.662(25)	2.560(8)
^{95}Zr	A06808	69.4(8)	75.42(18)	0.920(11)
^{95}Nb	A06808	121.6(17)	75.42(18)	1.61(3)
^{125}Sb	A06736	146.0(7)	49.77(3)	2.933(14)
^{133}Ba	A06814	47.0(4)	51.792(8)	0.907(6)
^{134}Cs	A06813	10.61(8)	12.2990(11)	0.863(7)
^{137}Cs	A06612	35.54(25)	18.414(8)	1.930(14)
^{144}Ce	A06809	69.5(5)	21.4894(20)	3.232(22)
^{241}Am*	A06809	2.92(12)	21.4894(20)	0.136(6)
^{152}Eu	A06812	276.5(19)	70.667(16)	3.91(3)
^{154}Eu*	A06812	0.80(12)	70.667(16)	0.0113(18)
^{155}Eu	A06741	14.40(11)	10.6691(23)	1.350(10)

The solution in B07073 was diluted three times to produce the GL sample in B07139 (Table C12). All dilutions were validated using gamma-ray spectrometry. In total, 24.988 kg of GL sample was produced.

Table C12 – Preparation of solution for GL source B07139

Nuclide	Gravimetric Dilution Factor GL GDF2	Gravimetric Dilution Factor GL GDF3	Gravimetric Dilution Factor GL GDF4	B07139 Act. conc. (Bq kg^{-1})
^{60}Co	60.786(20)	60.105(24)	59.78(3)	11.72(4)
^{95}Zr	60.786(20)	60.105(24)	59.78(3)	4.21(5)
^{95}Nb	60.786(20)	60.105(24)	59.78(3)	7.38(10)
^{125}Sb	60.786(20)	60.105(24)	59.78(3)	13.43(7)
^{133}Ba	60.786(20)	60.105(24)	59.78(3)	4.15(3)
^{134}Cs	60.786(20)	60.105(24)	59.78(3)	3.95(3)
^{137}Cs	60.786(20)	60.105(24)	59.78(3)	8.84(6)
^{144}Ce	60.786(20)	60.105(24)	59.78(3)	14.80(10)
^{241}Am*	60.786(20)	60.105(24)	59.78(3)	0.622(25)
^{152}Eu	60.786(20)	60.105(24)	59.78(3)	17.91(12)
^{154}Eu*	60.786(20)	60.105(24)	59.78(3)	0.052(8)
^{155}Eu	60.786(20)	60.105(24)	59.78(3)	6.18(5)

C7 GH samples

A mixed radionuclide solution (B07072) was prepared by mixing and diluting standardised solutions of the individual nuclides (Table C13). The chemical form of the GH samples was 2 M HCl containing 0.051 mg g^{-1} Ba, 0.045 mg g^{-1} Co, 0.038 mg g^{-1} Cs, 0.055 mg g^{-1} Eu, 0.050 mg g^{-1} Sb and 0.032 mg g^{-1} Zr. The dilutions were validated using gamma-ray spectrometry.

Table C13 – Starting material B07072

Nuclide	Source identifier	Activity conc. (kBq g^{-1})	Gravimetric Dilution Factor GDF1	B07072 Act. conc. (kBq g^{-1})
^{60}Co	A06811	196.3(6)	123.78(9)	1.586(5)
^{95}Zr	A06808	69.4(8)	104.77(3)	0.662(8)
^{95}Nb	A06808	121.6(17)	104.77(3)	1.161(16)
^{125}Sb	A06736	146.0(7)	87.178(20)	1.674(8)
^{133}Ba	A06814	47.0(4)	118.90(7)	0.395(3)
^{134}Cs	A06813	10.61(8)	96.89(5)	0.1095(8)
^{137}Cs	A06612	35.54(25)	99.5(3)	0.357(3)
^{144}Ce	A06809	69.5(5)	95.34(23)	0.729(6)
^{241}Am*	A06809	2.92(12)	95.34(23)	0.0306(12)
^{152}Eu	A06812	276.5(19)	149.9(4)	1.845(13)
^{154}Eu*	A06812	0.80(12)	149.9(4)	0.0053(8)
^{155}Eu	A06741	14.40(11)	39.79(5)	0.362(3)

The solution in B07072 was diluted once to produce the GH sample in B07074 (Table C14). The dilutions were validated using gamma-ray spectrometry. In total, 4.005 kg of GH sample was produced.

Table C14 – Preparation of solution for GH source B07074

Nuclide	Gravimetric Dilution Factor GH GDF2	B07074 Act. conc. (Bq g^{-1})
^{60}Co	97.17(10)	16.32(6)
^{95}Zr	97.17(10)	6.82(8)
^{95}Nb	97.17(10)	11.94(16)
^{125}Sb	97.17(10)	17.23(8)
^{133}Ba	97.17(10)	4.07(3)
^{134}Cs	97.17(10)	1.127(8)
^{137}Cs	97.17(10)	3.68(3)
^{144}Ce	97.17(10)	7.50(6)
^{241}Am*	97.17(10)	0.315(13)
^{152}Eu	97.17(10)	18.99(14)
^{154}Eu*	97.17(10)	0.055(9)
^{155}Eu	97.17(10)	3.72(3)

C8 C samples

The concrete samples originate from samples taken from a concrete bioshield of a decommissioned nuclear reactor which ceased operation ~25 years ago after ~20 years of operation. The concrete was thought to contain the following nuclides formed by neutron activation of concrete components: ^{3}H, ^{14}C, ^{41}Ca, ^{55}Fe, ^{60}Co, ^{63}Ni, ^{133}Ba, ^{152}Eu and ^{154}Eu.

The concrete core samples were crushed, mixed and sieved to <0.5 mm to form a homogeneous sample (~2.7 kg). The resulting powder was then heated overnight to 150 ºC to remove some of the tritium present in the sample as mobile tritiated water. Subsequently, fifty-two samples (50 g each) were prepared. Fourteen samples randomly selected were kept for homogeneity testing with gamma spectrometry (see Table C15 and Figures 70A-D).

One sample was analysed for its elemental composition with instrumental neutron activiation analysis. In total, 36 elements were detected. Three elements (Al, Ca and Si) were found to be present at levels of at least 1% by weight. Eight elements, including Ba [192(12) ppm] and Fe [0.680(8) wt%], were found to be present at levels between 100 ppm and 1% by weight. Seventeen elements, including Co [2.70(6) ppm), were found to be present at levels between 1 ppm and 100 ppm. Eight elements, including Eu [0.372(11) ppm], were found to be present at levels lower than 1 ppm. Nickel was not detected and it is likely to be present at levels below its detection limit (72 ppm). More information can be found in Appendix E.

Table C15 – Homogeneity tests

Nuclide	s_{bb} (%)	u_{meas} (%)	u_{int} (%)	u_{hom} (%)	u_{cons} (%)	$u_{N,rel}$ (%)
^{60}Co	1.09	0.92	1.02*	0.36	2.51	2.53
^{133}Ba	2.52	0.79	0.87*	2.37	4.22	4.84
^{152}Eu	10.6	0.60*	0.58	10.6	4.48	11.5
^{154}Eu	10.4	1.96	2.90*	10.0	3.03	10.4

* value used to estimate analytical uncertainty (see Section 2.7)

Appendix D. Dilution checks

Table D1 – Dilution checks AL and AH samples

	AL	AH
GDF2 vs. RDF2	100.14(17) vs. 100.34(9)	24.994(25) vs. 25.000(14)
zeta score DF2	**–1.02**	**–0.20**
GDF3 vs. RDF3	102.4(3) vs. 100.6(20)	–
zeta score DF3	**0.88**	–

Table D2 – Dilution checks BL and BH samples

	BL	BH
GDF2 vs. RDF2	35.609(11) vs. 35.69(5)	79.74(7) vs. 79.86(6)
zeta score DF2	**–1.43**	**–1.40**
GDF2 vs. RDF2 (^3H)	35.635(11) vs. 35.69(5)	79.96(7) vs. 79.86(6)
zeta score DF2 (^3H)	**–0.97**	**1.14**
GDF3 vs. RDF3	35.18(3) vs. 35.34(8)	–
zeta score DF3	**–1.44**	–
GDF3 vs. RDF3 (^3H)	35.28(3) vs. 35.34(8)	–
zeta score DF3 (^3H)	**–0.53**	–
GDF4 vs. RDF4	36.190(11) vs. 34.2(11)	–
zeta score DF4	**1.90**	–
GDF4 vs. RDF4 (^3H)	36.226(11) vs. 34.2(11)	–
zeta score DF4 (^3H)	**1.94**	–

Table D3 – Dilution checks B2 samples

	^3H (HTO)	OBT, ^{14}C, ^{36}Cl and ^{129}I
GDF2	35.112(12)	–
GDF2	–	35.072(12)
RDF2	35.05(12)	35.05(12)
zeta score DF2	**0.54**	**0.20**
GDF3	34.918(9)	–
GDF3	–	34.887(9)
RDF3	34.95(6)	34.95(6)
zeta score DF3	**–0.49**	**–1.00**

Table D4 – Dilution checks GL and GH samples

	GL	GH
GDF1 vs. RDF1 ^{60}Co	76.662(25) vs. 76.6(5)	123.78(9) vs. 120.8(12)
zeta score DF1 ^{60}Co	**0.10**	**2.43**
GDF1 vs. RDF1 ^{95}Zr	75.42(18) vs. 75.7(11)	104.77(3) vs. 104.3(17)
zeta score DF1 ^{95}Zr	**–0.24**	**0.26**
GDF1 vs. RDF1 ^{95}Nb	75.42(18) vs. 74.9(13)	104.77(3) vs. 103.3(18)
zeta score DF1 ^{95}Nb	**0.40**	**0.86**
GDF1 vs. RDF1 ^{125}Sb	49.77(3) vs. 49.2(7)	87.178(20) vs. 89.0(14)
zeta score DF1 ^{125}Sb	**0.91**	**–1.33**
GDF1 vs. RDF1 ^{133}Ba	51.792(8) vs. 52.9(6)	118.90(7) vs. 122.6(17)
zeta score DF1 ^{133}Ba	**–2.10**	**–2.19**
GDF1 vs. RDF1 ^{134}Cs	12.2990(11) vs. 12.25(18)	96.89(5) vs. 96.6(12)
zeta score DF1 ^{134}Cs	**0.24**	**0.21**
GDF1 vs. RDF1 ^{137}Cs	18.414(8) vs. 18.32(25)	99.5(3) vs. 99.6(14)
zeta score DF1 ^{137}Cs	**0.37**	**–0.06**
GDF1 vs. RDF1 ^{144}Ce	21.4894(20) vs. 21.6(5)	95.34(23) vs. 95.3(20)
zeta score DF1 ^{144}Ce	**–0.29**	**0.00**
GDF1 vs. RDF1 ^{152}Eu	70.667(16) vs. 71.4(7)	149.9(4) vs. 151.7(21)
zeta score DF1 ^{152}Eu	**–1.01**	**–0.86**
GDF1 vs. RDF1 ^{155}Eu	10.6691(23) vs. 10.7(4)	39.79(5) vs. 39.2(12)
zeta score DF1 ^{155}Eu	**0.04**	**0.47**
GDF2 vs. RDF2	60.768(20) vs. 60.89(11)	97.17(10) vs. 96.94(16)
zeta score DF2	**–0.95**	**1.22**
GDF3 vs. RDF3	60.105(24) vs. 60.8(5)	–
zeta score DF3	**–1.43**	**–**
GDF4 vs. RDF4s	59.78(3) vs. 58.6(25) to 62(3)	–
zeta scores DF4	**–0.47 < zeta < 1.33**	**–**

Appendix E. Elemental Composition of the concrete C samples

Major components	(% by weight)
Al	1.21(3)
Ca	26.0(3)
Si	15(3)

Minor components	(% by weight)
Ba	0.0192(12)
Fe	0.680(8)
K	0.53(2)
Mg	0.44(3)
Mn	0.0536(11)
Na	0.222(3)
Sr	0.067(6)
Ti	0.062(5)

Trace components	(ppm)
Br	1.13(6)
Ce	12.7(4)
Co	2.70(6)
Cr	19.2(12)
Cs	1.31(5)
Dy	1.2(2)
Ga	2.8(0.6)
Hf	1.11(6)
La	7.79(9)
Nd	7.9(8)
Rb	20.9(13)
Sc	2.03(2)
Sm	1.34(3)
Th	1.52(6)
U	1.57(11)
V	19.4(8)
Zr	80(16)

Ultra trace components	(ppm)
Au	0.0030(9)
Eu	0.372(11)
Lu	0.081(6)
Sb	0.44(3)
Ta	0.1(1)
Tb	0.20(2)
W	0.65(9)
Yb	0.58(3)

The following elements were not detected and their concentration is likely to be lower than the stated detection limit

	(ppm)
Ag	< 1.6
Cd	< 4.0
Cl	< 100
Cu	< 66
Er	< 71
I	< 4.2
In	< 0.083
Ir	< 0.0067
Mo	< 3.4
Ni	< 72
Pd	< 53
Se	< 0.76
Zn	< 5.3

Appendix F. Sample details

Lab code	AL	AH	BL	BH	GL	GH	B2	C	Date results received
3			x				x	x	15 June 2007
4	x		x		x	x	x	x	13 June 2007
5			x	x	x	x	x	x	10 July 2007
7		x		x	x	x	x		15 June 2007
8	x	x	x	x	x	x	x	x	15 June 2007
9						x			15 June 2007
13	x		x		x	x	x		14 June 2007
14		x		x		x			15 June 2007
15					x	x			15 June 2007
16				x		x	x		14 June 2007
17	x	x	x		x			x	14 June 2007
18						x		x	19 June 2007
19			x		x				19 June 2007
21		x	x	x	x	x	x	x	15 June 2007
22	x	x	x	x	x		x		12 June 2007
23					x				14 June 2007
25	x		x		x	x	x		15 June 2007
26	x					x			15 June 2007
27					x	x			14 June 2007
28	x	x	x	x	x	x	x	x	18 June 2007
29	x				x		x	x	11 June 2007
30				x	x		x	x	16 June 2007
32		x	x			x		x	13 July 2007
34	x		x		x		x	x	18 June 2007
35	x	x	x		x	x	x	x	2 July 2007
38	x			x	x		x	x	2 July 2007
39	x				x				29 June 2007
40	x		x		x		x	x	13 June 2007
41		x		x	x				13 June 2007
42	x				x				15 June 2007
45						x			11 June 2007
46		x		x	x	x	x		13 June 2007
47	x	x			x	x			7 June 2007
48						x		x	27 June 2007
52					x	x		x	29 April 2007
53			x		x	x		x	11 June 2007
54					x	x		x	15 June 2007
55		x		x		x			15 June 2007
56	x		x		x			x	18 June 2007
58					x			x	20 June 2007
59						x			14 June 2007
61					x	x			8 June 2007
62					x				14 June 2007
65	x				x				15 June 2007
66	x	x	x	x	x		x	x	6 July 2007
67						x			19 June 2007
68	x				x	x			20 July 2007
69		x							13 June 2007

continues

continued

Lab code	AL	AH	BL	BH	GL	GH	B2	C	Date results received
71	x								29 June 2007
72					x		x		11 June 2007
73	x	x	x	x	x	x			22 June 2007
74		x		x		x		x	15 June 2007
75	x		x		x		x		15 June 2007
76			x		x				15 June 2007
77						x			8 June 2007
78				x					9 July 2007
79						x			13 June 2007
80						x			6 June 2007
81					x		x	x	20 June 2007
82					x	x			15 June 2007
83					x	x			18 June 2007
84					x			x	4 June 2007
85				x		x		x	13 June 2007
86					x	x		x	18 June 2007
87					x	x			29 June 2007
Total	**23**	**17**	**21**	**18**	**45**	**39**	**22**	**27**	**212**

Appendix G. Example Kiri plot

The following example illustrates the use of a Kiri plot. Assume the following ten results.

Figure G1. Deviation plot example

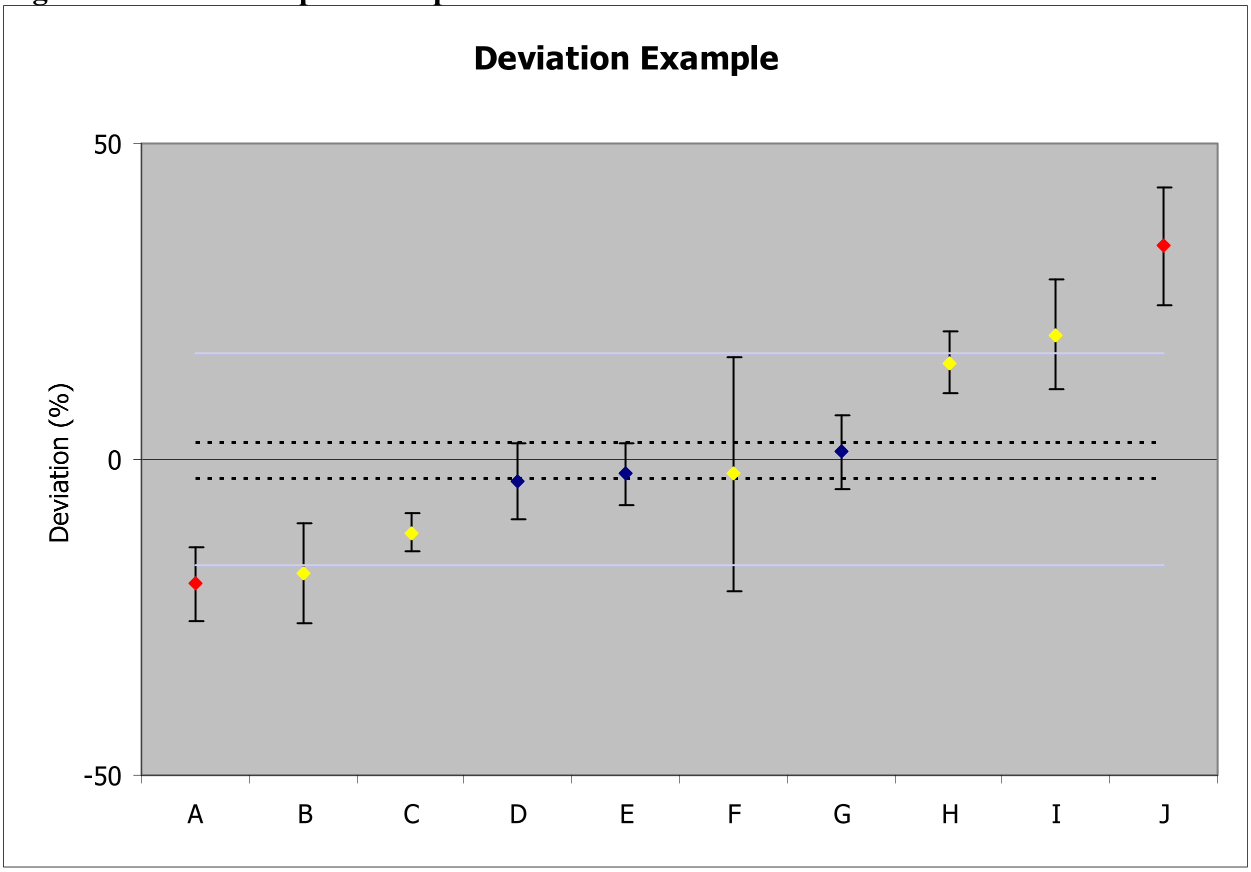


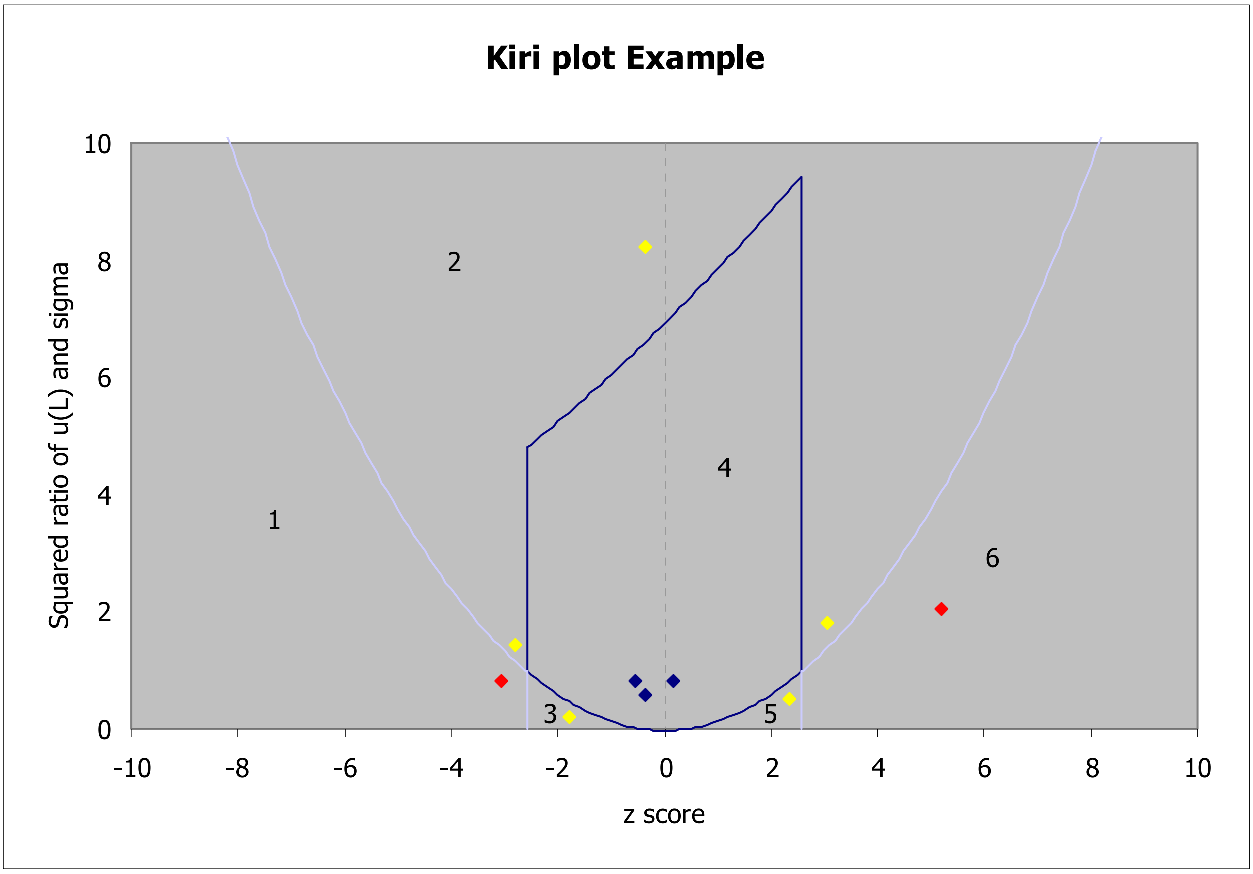
Table G1 – Data classification

Lab	Zeta test	R_L outlier test	z test	Verdict
A	fail	pass	fail	D
B	pass	pass	fail	Q
C	fail	pass	pass	Q
D	pass	pass	pass	A
E	pass	pass	pass	A
F	pass	fail	pass	Q
G	pass	pass	pass	A
H	fail	pass	pass	Q
I	pass	pass	fail	Q
J	fail	pass	fail	D

A Kiri plot relates the z-score (a measure how close a result is to the assigned value) with the squared ratio of the uncertainty of laboratory value and the uncertainty for proficiency assessment. A "perfect" result will have a z score of 0 and ratio of 0 (point 0,0). A Kiri plot consists of six zones (Zones 1 and 6 "Discrepant"; Zones 2, 3 and 5 "Questionable"; Zone 4 "In agreement") whose areas are defined by the three test used above to classify the data. The areas of Zones 1, 3, 4 and 5 are finite, while the areas of Zones 2 and 6 are infinite.

The Kiri plot for the values used for Figure G2 is shown below.

Figure G2. Kiri plot example



Lab A is not close to the assigned value and its uncertainty is too small to pass the zeta test (verdict: "Discrepant"; Kiri plot Zone 1).

Lab B and I are not close to the assigned value, but their uncertainty is large enough to pass the zeta test (verdict: "Questionable"; Kiri plot Zone 2)

Lab C is close enough to the assigned value, but its uncertainty is too small to pass the zeta test (verdict: Questionable; Kiri plot Zone 3)

Lab D, E and G are close to the assigned value (verdict: "In agreement"; Kiri plot Zone 4)

Lab F is close to the assigned value, but its uncertainty is too large to pass the R_L outlier test (verdict: "Questionable"; Kiri plot Zone 2)

Lab H is close enough to the assigned value, but their uncertainty is too small to pass the zeta test (verdict: "Questionable"; Kiri plot Zone 5)

Lab J is not close to the assigned value and their uncertainty is too small to pass the zeta test (verdict: "Discrepant"; Kiri plot Zone 6)

Appendix H. Outliers

The following procedure was used to detect outliers in both the relative uncertainty data set. Data points greater than the upper quartile (75%), Q_U, plus three times the interquartile range are classified as outliers. This method is unable to identify outliers if the data set contains fewer than 7 results.

Upper critical value: $c_U = Q_U + 3\,IQR = Q_U + 3\left(Q_U - Q_L\right) = 4\,Q_U - 3\,Q_L$

Example
Dataset: 1, 7, 8, 8, 9, 10 and 25
$Q_L = 7$ and $Q_U = 10$; $c_U = 10 + 3\ (10 - 7) = 19$
The data point with value 25 is therefore an outlier.

Table H1 – Relative uncertainty outliers

Nuclide	Laboratory	Relative uncertainty (%)	Critical value (%)
^{226}Ra AL	8	44	34
^{241}Am AL	66	21	20
^{226}Ra AH	8	41	30
^{90}Sr BH	8	29	22
^{95}Zr GL	41	47	40
^{95}Nb GL	84	56	31
^{95}Nb GL	41	33	31
^{137}Cs GL	41	82	27
^{152}Eu GL	41	34	21
^{60}Co GH	4	21	16
^{95}Nb GH	82	27	20
^{137}Cs GH	4	38	15
^{60}Co C	4	40	29

Appendix I. Nuclear data

Table I1 – Half-lives

Nuclide	Half-life (d)	Reference
^{3}H	4497(9)	DDEP
^{14}C	2.082(11) × 10^{6}	DDEP
^{36}Cl	1.099(11) × 10^{8}	DDEP
^{40}K	4.62(5) × 10^{11}	DDEP
^{41}Ca	3.7(3) × 10^{7}	NuDat
^{55}Fe	1003(3)	DDEP
^{60}Co	1925.2(3)	DDEP
^{63}Ni	3.60(9) × 10^{4}	DDEP
^{89}Sr	50.57(3)	DDEP
^{90}Sr	10520(30)	DDEP
^{95}Zr	64.032(6)	DDEP
^{95}Nb	34.991(6)	DDEP
^{99}Tc	7.8(3) × 10^{7}	DDEP
^{125}Sb	1007.54(9)	DDEP
^{129}I	5.88(26) × 10^{9}	DDEP
^{133}Ba	3849.7(22)	DDEP
^{134}Cs	753.5(10)	IAEA
^{137}Cs	10976(30)	DDEP
^{144}Ce	285.1(6)	IAEA
^{152}Eu	4939(6)	DDEP
^{154}Eu	3141.5(14)	DDEP
^{155}Eu	1736(5)	DDEP
^{226}Ra	5.844(26) × 10^{5}	DDEP
^{237}Np	7.82(4) × 10^{8}	DDEP
^{238}U	1.6319(18) × 10^{12}	DDEP
^{238}Pu	32046(11)	DDEP
^{239}Pu	8.802(4) × 10^{6}	DDEP
^{241}Am	1.5800(22) × 10^{5}	DDEP
^{244}Cm	6615(11)	DDEP

DDEP – Decay Data Evaluation Project (DDEP): www.nucleide.org/DDEP_WG/DDEPdata.htm
IAEA – http://www-nds.iaea.org/xgamma_standards/
NuDat – NuDat - ENSDF data: www.nndc.bnl.gov/nudat2/

Appendix J. Critical values for Student's t-test

Degrees of freedom	Critical t value (99%)
1	63.656
2	9.925
3	5.841
4	4.604
5	4.032
6	3.707
7	3.499
8	3.355
9	3.250
10	3.169
11	3.106
12	3.055
13	3.012
14	2.977
15	2.947
16	2.921
17	2.898
18	2.878
19	2.861
20	2.845
21	2.831
22	2.819
23	2.807
24	2.797
25	2.787
26	2.779
27	2.771
28	2.763
29	2.756
30	2.750
∞	2.576

Appendix K. Standard deviation for proficiency assessment; NPL and ISO approach

For all samples in this exercise except the C samples, the standard uncertainty for proficiency assessment is calculated according to:

$\sigma_p = R_{med} N$ (see Section 2.6)

For the C samples, the standard deviation for proficiency assessment is calculated according ISO 13528:2005:

$\sigma_p = s^*$ (see Section 2.7)

In both cases the values are used to calculate the *z* scores:

$$z = \frac{L - N}{\sigma_p}$$

According to ISO 13528:2005 the standard deviation for proficiency assessment can be determined by:

6.2 Prescribed value
6.3 Perception
6.4 From a general model
6.5 From the results of a precision experiment
6.6 From data obtained in a round of a proficiency testing scheme

In case of ISO Sections 6.2 and 6.3, the standard deviation for proficiency assessment value is simply set at a value (e.g., at 5% or 10%), which we feel is not appropriate for the NPL exercise. ISO sections 6.4 and 6.5 are not applicable, because in the NPL Environmental Radioactivity PTE there is no standard measurement method and, consequently, there is no information on the repeatability and reproducibility of this method. Instead, the participants are asked to submit a result with its corresponding uncertainty, which is likely to consist mostly of Type B uncertainty (e.g., counting statistics, calibration uncertainty, weighing, etc.). The dominance of Type B uncertainty set this type of exercise apart from exercises where Type A uncertainties are more prevalent (e.g., in chemistry PTEs) or exercises where there is no requirement to submit an uncertainty value.

The philosophy of the NPL approach to calculation of the standard deviation for proficiency assessment for all aqueous samples is similar to ISO Section 6.6 but the calculation differs from the ISO approach. Instead of using the robust standard deviation of the results themselves (as was done for the C samples; see below), the product of median of the participant's submitted relative uncertainties and the assigned value is used. (see Section 2.6). The ISO approach ignores the submitted uncertainties and the calculation of the standard deviation for proficiency assessment (and ultimately the *z* score) is based on the spread of the submitted results. The NPL approach is analogous to selecting the internal uncertainty when calculating the uncertainty of a weighted mean, instead of selecting the external uncertainty (ISO approach). [Regarding weighted means, it is common practice to compare both uncertainties (e.g., by an *F*-test) and select the largest value. We could implement a similar approach (i.e., calculate the robust standard deviation and the result of the current NPL approach, and select the larger value) when calculating the standard deviation for proficiency assessment values in future exercises.]

In practice, the obtained values for median of the participants' submitted relative uncertainties are robust and generally close to 5% for the alpha and gamma emitters and around 10% for the beta emitters (see Section 3.11), which is not surprising considering the different techniques used (alpha spectrometry, mass spectrometry, liquid scintillation counting, gas-flow proportional counting and gamma spectrometry). The expected uncertainties also depend on the activity levels in the samples and the composition of the samples (e.g., certain radionuclides interfere with the measurement of other radionuclides), which differ for every exercise (although the values for the 2007 Exercise were in general similar to the values obtained for the 2005 Exercise). Table K1 lists the results of both approaches and shows the ratios between the ISO σ_p and the NPL σ_p. In general, the ratios are close to unity; only in few cases, where there is a large spread in the submitted results, is the ratio much larger than unity [i.e., ^{237}Np and gross alpha (AL), ^{3}H and ^{63}Ni (BL), ^{63}Ni, ^{90}Sr and gross beta (BH), ^{95}Nb (GL) and ^{14}C (B2)].

For the data treatment of the C samples, the ISO approach was followed (see Table K2). The rationale behind this is as follows: both the assigned value N and the uncertainty of the assigned value u_N were in this case determined by the participants's results (and the homogeneity uncertainty) and not by NPL (as was the case for the other samples).

Table K1 – Standard deviation for proficiency assessment; NPL and ISO approach

Nuclide	Number of results	σ_p (NPL)	σ_p (ISO 13528)	σ_p (ISO) / σ_p (NPL) Ratio
		(Bq kg^{-1})	(Bq kg^{-1})	
^{226}Ra (AL)	14	**0.71**	0.83	1.2
^{237}Np	4	**1.25**	4.28	3.4
^{238}U	21	**0.23**	0.29	1.3
^{238}Pu	20	**0.95**	0.71	0.7
^{239}Pu	20	**1.01**	0.60	0.6
^{241}Am	21	**0.56**	0.74	1.3
^{244}Cm	16	**0.77**	1.76	2.3
gross alpha	5	**4.9**	50.3	10
		(Bq g^{-1})	(Bq g^{-1})	
^{226}Ra (AH)	14	**0.29**	0.74	2.5
^{237}Np	7	**1.24**	1.20	1.0
^{238}U	16	**0.10**	0.16	1.7
^{238}Pu	12	**0.88**	1.48	1.7
^{239}Pu	12	**0.42**	0.46	1.1
^{241}Am	17	**0.16**	0.29	1.8
^{244}Cm	13	**0.88**	1.50	1.7
gross alpha	2	**3.73**	2.57	0.7
continues				

continued

Nuclide	Number of results	σ_p (NPL)	σ_p (ISO 13528)	σ_p (ISO) / σ_p (NPL) Ratio
		(Bq kg^{-1})	(Bq kg^{-1})	
^{3}H (BL)	15	**0.99**	4.02	4.1
^{55}Fe	2	**1.52**	0.88	0.6
^{63}Ni	4	**0.98**	3.09	3.1
^{89}Sr	6	**2.76**	6.03	2.2
^{90}Sr	16	**1.02**	1.84	1.8
^{99}Tc	9	**1.63**	2.19	1.3
gross beta	4	**3.05**	3.11	1.0
		(Bq g^{-1})	(Bq g^{-1})	
^{3}H (BH)	16	**0.13**	0.14	1.1
^{55}Fe	7	**0.42**	0.22	0.5
^{63}Ni	6	**0.49**	2.54	5.2
^{89}Sr	8	**0.74**	1.73	2.3
^{90}Sr	15	**0.72**	2.51	3.5
^{99}Tc	7	**0.45**	0.30	0.7
gross beta	2	**2.04**	7.15	3.5
		(Bq kg^{-1})	(Bq kg^{-1})	
^{3}H total (B2)	14	**43**	62	2.1
^{14}C	13	**15**	54	3.7
^{36}Cl	5	**28**	34	1.2
^{129}I	11	**16**	40	2.4
^{60}Co (GL)	45	**0.64**	0.59	0.9
^{95}Zr	41	**0.41**	0.51	1.2
^{95}Nb	39	**0.50**	2.89	5.8
^{125}Sb	43	**0.83**	0.81	1.0
^{133}Ba	42	**0.27**	0.38	1.4
^{134}Cs	43	**0.27**	0.38	1.4
^{137}Cs	45	**0.53**	0.32	0.6
^{144}Ce	41	**1.06**	0.88	0.8
^{152}Eu	42	**1.00**	1.71	1.7
^{155}Eu	43	**0.49**	0.62	1.3

continues

continued

Nuclide	Number of results	σ_p (NPL)	σ_p (ISO 13528)	σ_p (ISO) / σ_p (NPL) Ratio
		(Bq g^{-1})	(Bq g^{-1})	
^{60}Co (GH)	39	**0.66**	0.48	0.7
^{95}Zr	35	**0.27**	0.35	1.3
^{95}Nb	33	**0.64**	1.33	2.1
^{125}Sb	36	**0.74**	0.64	0.9
^{133}Ba	36	**0.18**	0.19	1.1
^{134}Cs	37	**0.05**	0.07	1.4
^{137}Cs	39	**0.14**	0.18	1.2
^{144}Ce	35	**0.37**	0.30	0.8
^{152}Eu	36	**0.88**	0.75	0.9
^{155}Eu	34	**0.18**	0.23	1.2

Table K2 – Standard deviation for proficiency assessment; NPL and ISO approach

Nuclide	Number of results	σ_p (NPL)	σ_p (ISO 13528)	σ_p (ISO) / σ_p (NPL) Ratio
		(Bq g^{-1})	(Bq g^{-1})	
^{3}H total (C)	9	1.0	**3.6**	3.5
^{3}H leach	5	0.12	**1.3**	11
^{3}H fixed	2	1.1	**2.0**	1.9
^{14}C	5	0.027	**0.18**	7.0
^{40}K	6	0.015	**0.074**	4.8
^{41}Ca	3	0.073	**0.20**	2.8
^{55}Fe	3	0.0082	**0.019**	2.3
^{60}Co	26	0.0040	**0.0077**	1.9
^{63}Ni	3	0.0030	**0.0034**	1.1
^{133}Ba	24	0.0034	**0.0091**	2.7
^{137}Cs	2	0.00029	**0.00020**	0.70
^{152}Eu	25	0.058	**0.21**	3.6
^{154}Eu	21	0.0039	**0.0053**	1.4
^{226}Ra	2	0.031	**0.00016**	0.0051
^{228}Ra	2	0.00091	**0.0020**	2.2

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Appendix M. Literature

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