UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA

December 29, 2017

George ("Pat") Brooks
US Department of the Navy
33000 Nixie Way, Bldg 50
San Diego, CA 92147

Dear Mr. Brooks:

Thank you for providing for review the *Draft Radiological Data Evaluation Findings Report for Parcels B and G Soil* ("Report"), Former Hunter's Point Naval Shipyard (HPNS), September 2017. The U.S. Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the California Department of Public Health (CDPH) have independently reviewed this report in detail with a technical team including national experts in health physics, geology, and statistics, and EPA's comments are attached.

In Parcel B, the Navy recommended resampling in 15% of soil survey units in trenches, fill, and building sites. EPA, DTSC, and CDPH found signs of potential falsification, data manipulation, and/or data quality concerns that call into question the reliability of soil data in an additional 76% of survey units, bringing to 90% the total suspect soil survey units in Parcel B. (These do not add exactly due to rounding). In Parcel G, the Navy recommended resampling 49% of survey units, and regulatory agencies recommended 49% more, for a total of 97% of survey units as suspect.

Below are examples of observed forms of potential falsification, data manipulation or data quality concerns identified in reviews by EPA, DTSC, and CDPH:

- In Parcel G, in nearly a third of trench units, gamma scans of soil surfaces after excavation showed a need for further biased soil samples to be collected, but they were not.
- In Parcel G, out of the 43 trench units that the Navy had not already recommended resampling:
    - Over half had inconsistencies between gamma scan and static data and over one-third had other types of inconsistencies (e.g. on-site and off-site lab results differ by more than 10 times, plots showed signs that multiple sources of soil were likely in the data set, etc.)
    - In a third, the narrow range of gamma static data indicates measurements were not collected from different locations, as required.
    - In six, some data were missing so some evaluations could not be done.
    - In a few trench units, biased sample results appeared lower than other data sets. Biased samples are supposed to be collected in locations of highest scan results, so they would be expected to be higher, not lower, than other data sets collected in random locations.
    - Other concerns were found through data evaluation, and most trench units showed red flags of multiple types.
- In Parcel B, in some samples, the weights recorded for the onsite lab differed significantly from that recorded for what should be the same sample sent to the offsite lab.

- In Parcel B, in some samples, the weights recorded for the onsite lab differed significantly from that recorded for what should be the same sample sent to the offsite lab.
- Generally, data from Parcel B trench units show fewer examples of signs of deliberate falsification, but they show more frequent examples of data quality concerns. For example, a quarter of trench unit reports were missing gamma scan and static data. Many lab results were zero or negative numbers.

In summary, the data analyzed demonstrate a widespread pattern of practices that appear to show deliberate falsification, failure to perform the work in a manner required to ensure ROD requirements were met, or both.

We look forward to working with the Navy to scope out and begin the sampling component of the radiological assessment effort as soon as possible. If you would like to discuss any of these comments, please contact me at 415-972-3005 or chesnutt.john@epa.gov. You may also contact Lily Lee, Remedial Project Manager, on my staff at 415-947-4187 or lee.lily@epa.gov.

Sincerely,

John Chesnutt
Manager, Pacific Islands and Federal Facilities Section
Superfund Division

Attachments

cc: Julie Pettijohn, DTSC
Sheetal Singh, CDPH
Alec Naugle, California Regional Water Quality Control Board
Amy Brownell, San Francisco Department of Public Health

EPA Review of Draft *Radiological Data Evaluation Findings Report for Parcels B and G Soil, Former Hunters Point Naval Shipyard, San Francisco, California, September 2017.*

EPA Comments dated December 2017

Introduction and Background

The Report addresses soil cleanup work in Parcels B and G, which together make up approximately 40% of the total radiological soil survey units that Tetra Tech EC, Inc., worked on at the Hunters Point Naval Shipyard.

Radiologically impacted sites identified in the 2004 Historical Radiological Assessment (HRA) for Parcel B were used for various functions including: personnel barracks, radioactive waste storage, general shops, industrial laboratories, maintenance and machine shops, and radioluminescent device collection points. The Parcel B radiologically impacted structures included Buildings 103, 113, 113A, 130, 140, 146, and the Building 140 Discharge Channel. The radiologically impacted former building sites included 114, 142, and 157.[1]

In addition, the Navy has found radiological contamination in portions of Parcel G, such as in the southeastern corner (associated with the buildings and the "peanut spill") and in the sewers along Cochrane Street due to previous testing during the Phase I through Phase V Radiological investigations/cleanups. The 2004 HRA indicates that Cs-137 was found at high concentrations in sediment from a manhole along Cochrane Street.

To be able to concur on a Finding of Suitability for Transfer (FOST), the EPA needs to evaluate the record to determine if it supports a conclusion that the Record of Decision (ROD) conditions have been met. The ROD for Parcel G states: "Buildings, former building sites, and excavated areas will be surveyed after cleanup is completed to ensure that no residual radioactivity is present at levels above the remediation goals. Excavated soil, building materials, and drain material from radiologically impacted sites will be screened and radioactive sources and contaminated soil will be removed and disposed of. . . ."[2] The above also applies to Parcel B.

The Navy's internal quality control review discovered discrepancies in the soil samples in 2012 and required an investigation, resampling, and new excavations at that time. In February, 2016, the Nuclear Regulatory Commission (NRC) documented "failure by Tetra Tech to make or cause to be made, surveys that were reasonable to evaluate concentrations and potential radiological hazards of residual radioactivity in the soil at HPNS."[3] Due to these and other recent developments, the Navy has prepared this report as one step in its process "to assure that human health and the environment are being protected."

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[1] Department of Navy, *Final Radiological Removal Action Completion Report*, Parcel B, Hunters Point Naval Shipyard, DCN: ECSD-3211-0018-0182, CTO No. 0018, 2012.

[2] *Final Record of Decision for Parcel G, Hunters Point Shipyard, San Francisco, California*, February 18, 2009, Section 2.9.2, p. 44.

[3] NRC Office of Investigations Report No. 1-2014-018 (https://www.nrc.gov/docs/ML1604/ML16042A074.pdf)

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EPA's attached comments on the draft report include the following:

1. Comments on the Report's main text.
2. Tables summarizing findings
3. Attachments:
    a. Review Guidelines for Parcel G (EPA used similar for Parcel B)
    b. Supplemental statistical analyses for some individual trench units that support the conclusions from the review described in the spreadsheet
4. Excel Workbooks with spreadsheets with reviews for Parcels B and G showing, by Trench Unit, evidence of potential falsification and potential failure to document adequately that ROD requirements have been met. Other sheets within these workbooks show various forms of summaries.

These comments are based on our review of the draft Report contents, radiological data, associated supplemental statistical analyses, the Navy's 2004 HRA, the 2014 Tetra Tech EC Inc., internal investigation, the 2016 NRC "Notice of Apparent Violation," the 2017 Greenaction "Petition to Revoke Materials License No. 29-31396-01 [of Tetra Tech EC, Inc.]" sent to the NRC, and other public documents. Please note that these reviews do not include a comprehensive analysis of allegations that may contain enforcement confidential information. Any such information does not appear to be likely to alter overall broad conclusions.

EPA is making every effort to include in our formal comments everything that we have already conveyed via email and all the comments that our reviewers have on this report to-date. If significant new information comes to light or significant new insights result from further evaluation, EPA may supplement these comments at a later date.

General Comments

1. Executive Summary: This Report will likely attract interest from a broad audience that will include laypeople. The Executive Summary needs to be understandable to this broad audience. It should begin with more context, including a broad overview of next steps. It should be written in "plain language" with references added to direct the reader to more information within the body of the report. This same language can be used as the basis for the Navy's fact sheet on the same subject. Please consider writing the bullets of allegations and defined recommendations portions using terms easily understood by a layperson.

2. Executive Summary: The Navy wrote in Section 1.3, p. 1-2, "Because it is impossible to determine whether every instance of potential data manipulation or falsification has been identified, the Navy recommends additional surveys and sampling beyond the areas with evidence of data manipulation. Additional soil sampling locations will be selected in coordination with the regulatory agencies." EPA agrees with this statement. This important statement needs to be up front in the Executive Summary as early as possible. Based on this information, the designation "No Further Action" for some survey units contradicts the above statement and could mislead a reader. Please choose a more accurate term to describe the survey units that fall into this category. This statement

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should be repeated in the report wherever relevant (e.g. in locations where "no further action" is currently written) to avoid potential misunderstandings.

3. Executive Summary, Page iii and iv and Section 4.0, p. 4-1: The draft states "The purpose for the reanalysis is to a) compare the initial systematic sample results to the release criteria to see if the results may reveal that the release criteria were met and remediation was not required even though final systematic sample results were potentially manipulated and falsified, or b) provide offsite laboratory results to document current site conditions." Revisiting archived samples can indeed be another way to find evidence of falsification. However, if a trench unit shows signs of potential falsification of work, then reanalysis or physical inspection of archived samples cannot by itself provide sufficient documentation that Record of Decision (ROD) requirements have been met. Specifically, the re-analysis of archived samples should not be considered reliable for providing defensible data for decision making for the following reasons:

    - Overall, review of Parcel G data evaluation results have shown such widespread failures to follow proper practices in so many aspects of the characterization process that the archived samples cannot be considered reliable indicators of actual conditions at the first round of sampling. More specifically, Parcel G, Building 364, Survey Unit 27 showed indication of potential falsification in the first and only round of sampling.

    - Former workers have alleged that in the building where samples were stored, samples were spilled on the floor, and in addition, workers did not properly secure radiological controlled areas. Therefore, cross-contamination or sample tampering could have occurred.

    - Global Positioning System (GPS) coordinates were not collected during the majority of sample collection events. Therefore, the locations where samples were collected cannot be confirmed. In addition, former workers have alleged that samples were collected purposely from areas where gamma scans showed the lowest readings, rather than the highest readings. In Parcel G, the following observations are indicators of this potential concern: 1) in box plots and Q-Q plots biased samples have shown low variability and have mean values below other data sets and 2) statements in forms that gamma scans and gamma statics are inconsistent with each other and/or with the Final Status Survey samples. A recent Nuclear Regulatory Commission (NRC) enforcement action confirmed that samples were sometimes purposefully not collected from the appropriate locations in violation of the Work Plan requirements. This would be difficult to verify even if the samples are physically examined for consistency with other samples collected from the same survey unit.

    - The Navy's Data Evaluation Forms indicate that some of the Survey Unit Project Reports (SUPRs) are missing the chain-of-custody forms (COCs) for samples collected at various survey units. Further, worker allegations state that some

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COCs were falsified. Based on a review of these forms, allegations regarding COC tampering/falsification have been confirmed by the Navy. COCs provide documentary evidence to authenticate who, where, and when samples were collected, transported, and analyzed. Signed and dated COC documentation is also required to verify that custody of the samples was maintained by the appropriate personnel from the time of collection through analysis and storage, in order to prove that the samples were not tampered with or altered. Any archived samples which do not have the appropriate COC documentation, or which may have an accompanying COC but which have not been maintained in a locked room under controlled custody as evidenced by signed COC documentation, cannot be used to provide defensible data regarding site conditions.

Please revise the Report to remove all references to re-analysis of archived samples as a means to verify compliance with release criteria in accordance with the Hunter's Point Naval Shipyard (HPNS) Record of Decision (ROD).

4. Executive Summary, page vi, last bullet, and Section 1.3 (Assumptions and Uncertainties), page 1-2, The last bullet, state that data quality was not evaluated by the Navy. The text further states that data quality has been assessed and approved by the Navy and regulatory agencies in previous reports, indicating that data quality should not be re-considered in the review of data and environmental decision making. The data quality related to Tetra Tech EC, Inc., work, including its laboratories, should be considered regardless of the prior approval by the Navy or any of the regulatory agencies. A re-review of the data based on former worker allegations has also brought to light data quality concerns not previously identified.

   For example,

   - The contract off-site laboratory had data quality issues such as the identification of sets of data with an unusual number of non-detect or negative values, and there were revelations about the use of inaccurate nuclide libraries for identifying and quantifying gamma emitting radionuclides. In some cases, the Ac-228 sample data was unusually low, or reported as '0' in Trench Units (TUs) 076, 077, 078, and 080 for all survey types. TUs 076, 077, 078, and 080 are all adjacent to Bldg. 411. TU077 is adjacent to TU076. Negative, zero and <1 Actinium values are off-site lab data, not on-site lab data, for the NFA TUs in Parcel G.

   - Additionally, for some survey units, significant discrepancies exist between on-site and off-site laboratories, with the concurrent identification of insufficient analysis procedures for identifying Radium-226 (Ra-226) contamination at the on-site laboratory. For example, it has been determined that the on-site laboratory analyzed for Ra-226 using the Ra-226 gamma energy line at 186 Kilo-electron volts (KeV) in

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the gamma spectroscopy analysis, but with insufficient counting time to achieve the required detection limits.

- In addition, multiple former workers have reported fraud associated with quality control and work plan requirements, such as the failure of some workers to follow work plans by scanning soil too quickly or with the detector too far from the surface to achieve the detection limit requirements for the analysis.

This newly identified information reveals a general lack of data quality and reliability, indicating the associated data are neither reliable nor defensible. Please revise the Report to remove reference to data quality issues not being considered in the evaluation of the usability and defensibility of the data and discuss issues associated with the allegations and how they may impact data quality. A more detailed discussion about data quality and the resampling effort is needed to provide assurance that any area not being resampled has defensible data, i.e., the work plan was followed and documentation exist with required signatures for surveys, COCs, reviews, and what those requirements were and how the Navy verified that the requirements in the work plan and release criteria have been met.

In the bigger picture, beyond the scope of this specific Report, prior to resampling efforts, a thorough review of work plans, process review, documentation, and data quality should be of primary concern to ensure that high quality defensible data is obtained. Ongoing onsite oversight by the Navy and regulatory agencies should be conducted frequently.

5. Executive Summary: Please add language to the end of the Executive Summary and in the Report's conclusion that answer the following questions: 1.) What happens next with each parcel? 2.) How does the public get involved? 3.) What actions need to take place for each of these parcels? and 4.) What needs to happen to initiate the restart of the transfer process for each of these parcels?

6. Section 2.3 (Release Criteria) states that the background activity used for Ra-226 in Parcels B and G is 0.485 Picocuries per gram (pCi/g), and that for soil in the United States, the expected Ra-226 activity is 1 pCi/g and can range up to 4 pCi/g; therefore, the HPNS background value for HPNS is conservative. The statement that use of the 0.485 pCi/g concentration as the average background concentration for Ra-226 at HPNS is conservative is not supported by current site-specific background data. In addition, Section 4 (Findings and Recommendations) states at the top of page 4-2 "After carefully examining the analytical data and the conceptual model for soil contamination, it is concluded that the upper range of naturally occurring Ra-226 exceeds the release criteria. Therefore, cleanup will be hampered without an understanding that naturally occurring Ra-226 may exceed the release criterion without being indicative of contamination." However, the Report has not provided data that supports this statement or provides sufficient information to identify definitively the background concentration range of Ra-226 at the HPNS. It is therefore recommended that the Navy consider generating a new set of representative background data from areas not impacted by HPNS operations for

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each Parcel or geographical area, incorporating the Quality Assurance requirements for this sampling in a new Sampling and Analysis Plan. Generation of such background data will provide defensible information for supporting decision making for newly generated data at the HPNS. As such, the following analytical parameters are requested to ensure the background data are comprehensive and meet the data quality objectives for determining which radionuclides of concern resulting from operations at the HPNS are present at levels that exceed the ROD release criteria:

Gamma Spectroscopy

- All naturally occurring decay chain radionuclides for the Uranium-238, Thorium-232 (Th-232), Uranium-235, including Pa-231, Th-227, Ra-223 should be quantified by gamma spectroscopy analysis to verify which areas are in secular equilibrium. Determining which radionuclides are in secular equilibrium will provide more information regarding natural background variations.
- Europium-152 (Eu-152) and Eu-154
- Potassium-40 (K-40)
- Non-anthropogenic radionuclides, including Americium-241 (Am-241), Cobalt-60 (Co-60)

Strontium

- Total Strontium and/or Strontium-90 (Sr-90)

Alpha Spectroscopy

- Isotopic Plutonium, Uranium, Thorium, and Am-241

Please revise the Report to discuss whether historical or newly generated background data will be used for future assessments regarding compliance with the HPNS ROD.

7. Section 2.5 Former Worker Allegations: Please revise this section as needed to ensure that where the findings in the forms appear to confirm any specific allegations, those specific allegations are included to the list in this section. In addition, please note which allegations have been confirmed from data evaluation, e.g. in parentheses after the particular bullet or in some other section.

8. Section 2.5 Former Worker Allegations: The Navy has already screened the chain of custody forms for names of people associated with allegations of falsification. EPA reviewed "Scan/Static Surveyor Name" and/or "Sampler/Surveyor Name" portions of the forms. Out of the 43 forms in Parcel G that the Navy recommended for "NFA," 23 of them listed names associated with allegations of falsification. EPA recommends that the Navy also search for names associated with falsification for these two categories listed above in its future reviews.

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As background, a person could have been on this list of "suspect names" for various reasons. For example:

- A former worker stated that s/he did falsify radiological work, often due to an or a perceived order from a supervisor
- A former worker stated that s/he observed this person falsifying radiological work
- A former worker stated that this person was on a crew that was associated with falsifying radiological work

As a caveat, if a name were on this list and did indeed falsify in one situation, that does not mean that s/he falsified in any given particular survey unit. In addition, a person's name being on this list does not mean definitely falsification occurred.

That being said, under normal circumstances, missing names or names associated with potential falsification may not by itself raise significant concerns that the record does not support that ROD requirements have been met. However, in this site, worker allegations have sometimes been confirmed to be true. For example, the NRC concluded enforcement action documented that tampering with Chain of Custody documentation was in some instances associated with attempts to under-represent the true extent of contamination. Therefore, certain names appearing as associated with a given parcel is considered one line of evidence to be weighed together with other lines of evidence as part of developing a conclusion about the need for resampling.

9. Section 3 Data Evaluation Activities, Page 3-1 states "(3) recommend additional data collection to confirm existing data, or replace potentially manipulated or falsified data." Old data should not be deleted even if it was proven to be falsified. It should be flagged as "rejected" data.

10. Section 3 Data Evaluation Activities, Page 3-1 End of first bullet: "Biased samples that were collected to determine the limits of soil exceeding the release criteria or to confirm the successful removal of soil exceeding the release criteria, were designated as "FSS-BIAS" and "RAS" in FRED, and are also referred to as "Confirmatory" and "Bias" in this evaluation." The FSS-Biased samples should not have been included in with the other RAS biased samples for plot evaluations during the FSS survey, but they were. This sentence needs to be reworded for accuracy.

11. Section 3 Data Evaluation Activities, Page 3-2: The draft states "Other naturally occurring radionuclides (including Th-232 progeny Bi-212 and lead (Pb)-212, and Ra-226 and progeny Pb-214) were evaluated when additional information was needed. ROCs not identified as primary radionuclides for this evaluation include Sr-90 and Cs-137, which are present in soil from fallout as a result of nuclear testing. Sr-90 was only analyzed in 10 percent of the soil samples, limiting its usefulness in the evaluation. Cs-137 is only discussed in the evaluation if exceedances of the release criterion in soil were reported." If Cs-137 was above the release criteria then additional analyses should have been performed as stated in Section 2.1 ("If Cs-137 results from the onsite laboratory were at or above the release criteria, isotopic plutonium, isotopic uranium, and Sr-90

were also analyzed by the offsite laboratory."). Please check this in the FRED database and develop a summary table to clarify if these additional analyses were performed.

12. Section 3 Data Evaluation Activities: After reviewing the data, there is evidence that some biased samples were not taken, even where gamma scan count rates exceeded investigation levels. Yet some survey units in which this occurred were not flagged for resampling. Please use consistent review decision rules, i.e. incorporating across the board the latest versions of internal criteria for conclusions regarding recommendations for resampling.

13. Section 3 Data Evaluation Activities: Attachment 1 of these comments shows overall guidelines that EPA has used in its reviews of forms and data for trench units and building site survey units. If any of these factors are not already being used by the Navy, please incorporate them into future reviews.

14. Section 3 Data Evaluation Activities: Please see the EPA's comments on the box plots and Q-Q plots submitted June 9, 2017, in which EPA gave the Navy recommendations from statisticians for displaying data in a manner that facilitates efficient reviews. The City created plots for Parcels B and G in this format and provided them to the Navy and agency reviewers. These have indeed proven to be effective time savers in EPA Parcel G reviews. Please add these to the final report. Please provide plots in a similar format for other Parcels before sending to the regulatory agencies for review.

15. Section 4 Findings and Recommendations, Section 4.0, p. 4-2: The draft states, "After carefully examining the analytical data and the conceptual model for soil contamination, it is concluded that the upper range of naturally occurring Ra-226 exceeds the release criteria. Therefore, cleanup will be hampered without an understanding that naturally occurring Ra-226 may exceed the release criterion without being indicative of contamination." When Navy did three rounds of attempts to separate storm drain and sewer lines, the fill consisted of many types of piping that were not original. Contamination could have spilled. All soil would have gotten mixed up. The Navy would need to perform alpha spectroscopy to show that Th-230 was in equilibrium with Ra-226 to conclude that Ra-226 is naturally occurring. Either delete this statement or give evidence in the form of laboratory results that Ra-226 present is naturally occurring. If the Navy wishes to establish new reference background levels, new sample collection would need to be located in areas that are established as unimpacted.

16. Section 4.1 Parcel B: EPA will provide comments on the Parcel B sections of this report at a later date. [Note: In this final version of comments, Parcel B General Comments begin with General Comment #21. The Parcel B spreadsheets and summary table are attached.]

17. Section 4.2 Parcel G, 4.2.1 Trench Units: The individual forms in Appendix C of this report give more specific documentation of signs of such "soil data manipulation and falsification" and give locations where the Navy recommends further action to address these problems. EPA has identified more locations with signs of falsification. The forms

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and data also document signs of failure to follow the workplan in multiple locations. In some locations, even when signs of falsification are not found, the record may not be complete enough to allow a determination that ROD conditions have been met. For example, the workplan requires that in addition to systematic soil samples using a grid, 100% scans are also necessary to identify potential hot spots missed between systematic samples. If scan results are missing or if they do not appear to represent a wide range of readings that would be typical, then a determination cannot be made about whether or not potential hotspots were identified and remediated. In these situations and others, further action is necessary before the EPA can concur on a FOST.

Some of the guiding principles of EPA's review included the following:

- Further action recommended action should be based on a technical decision, using best professional judgement, as to whether the record is sufficient to support a conclusion that the ROD requirements have been met to "ensure that no residual radioactivity is present at levels above the remedial goals." Otherwise EPA cannot concur on a FOST.

- If multiple explanations are possible for an observation in the record, then for purposes of recommendations for further action, reviewers should assume the worst case reasonable explanation.

- Any falsification anywhere in the process in a given survey unit calls into question any findings within that survey unit, and resampling is recommended. If the same team has done the work within a given survey unit, then they could have engaged in falsification during multiple aspects of work in that survey unit, even if statistical analysis did not identify additional evidence of falsification.

Results of EPA's review appear in the attached spreadsheet. The second column with an "overall score" indicates the following determinations:

- 2 = Sufficient evidence has already been found in the form, the FRED database, and/or other sources to conclude the resampling is necessary in this trench unit before EPA can conclude that the record supports that the ROD requirements have been met.

- 0 = No indications have been found thus far for particular concerns in this trench unit. However, as the Navy wrote in Section 1.3 of this draft report, "Because it is impossible to determine whether every instance of potential data manipulation or falsification has been identified, the Navy recommends additional surveys and sampling beyond the areas with evidence of data manipulation. Additional soil sampling locations will be selected in coordination with the regulatory agencies." (Section 1.3, p. 1-2)

In addition, EPA's statistician has created index plots for all Parcel G Trench Units the Navy recommended for "No Further Action" and more specialized plots for some

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individual Parcel G Trench Units (73, 75, 82, 91, and 121). These analyses are attached separately. The Trench Unit spreadsheet's final column show those trench units that have one of these specific analyses.

18. Section 4.2.2 Fill Units: EPA agrees with the Navy's approach to prioritize fill units for resampling in correspondence with the priority of the source trench units for resampling. That is, if the source trench is suspect, then the destination trench is also suspect. If any single source trench unit is suspect, then because of mixing of material from multiple sources during backfill, all the fill material for a given fill unit is suspect. For fill, EPA is also assuming that if either trench unit or fill unit are suspect then the entire unit needs rework for both trench and fill. Here are several reasons for this assumption. First, if crews are mobilized to sample in a trench unit anyway, this approach provides information about more locations with less additional work. Second, in some locations, the boundary between the fill and the previously unexcavated original fill may not be easy to tell. Documentation of depths and locations of excavation may not be reliable. Finally, cross-contamination could occur between fill and the previously unexcavated original fill.

    In Parcel G, based on the above criteria, the State Department of Toxic Substances Control (DTSC) analysis has concluded that all fill units require resampling. EPA has independently reviewed the findings of the DTSC and concurs with its recommendations.

    In other parcels, however, even if fill units have not received soil from suspect source trench units, they may still require resampling if they show additional signs of falsification related to Radiation Screening Yard evaluation or other signs that the data do not provide a sufficient record to confirm ROD conditions are met. As a practical matter for Parcel G, this situation is not relevant because 100% of fill units are already recommended for rescanning and/or resampling through the entirety of the trench unit anyway.

19. Section 4.2.3 Current and Former Building Sites: EPA has also independently reviewed the findings of the California Department of Public Health (CDPH) of Parcel G building site survey units of concern. EPA concurs with its recommendations for locations that require additional sampling. Please see attached spreadsheet for detailed analysis.

20. Section 4.3 Conclusions and Recommendations: Together, the EPA and the Navy found enough concerns to recommend resampling in 94% of trench units in Parcel G. The data analyzed demonstrate a widespread pattern of practices that appeared to show potential deliberate falsification, potential failure to perform the work required to ensure ROD requirements were met, or both. The data revealed not only potential purposeful falsification and fraud in terms of sample and/or data manipulation, they also reveal the potential failure to conduct adequate scans, a lack of proper chain of custody for ensuring samples were not tampered with, extensive data quality issues (including off-site laboratory data) and general mis-management of the entire characterization and cleanup project.

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These observations in the record call into question the performance of Tetra Tech EC, Inc., across all of Parcel G. Many of the same personnel in Tetra Tech EC, Inc., worked in a similar time period at nearby locations in Parcel G. The pervasiveness and magnitude of the documented wrongdoing makes it difficult to conclude that similar falsification did not also occur at the four out of 63 trench units where evidence of wrongdoing was not as apparent. Therefore, none of the data generated while Tetra Tech EC, Inc., was involved with the cleanup activities at Parcel G, can be deemed to be definitive or defensible to demonstrate in the record that ROD requirements have been met.

21. Section 2.1 of the Report presents a brief description of the conceptual site model (CSM). However, it is not complete. This should be revised to include more detail. The final Radiological Removal Action Completion Reports (RACRs) for Parcels B and G, Section 2.2 Conceptual Site Model, both cite the *Navy Memorandum for the Record: Conceptual Site Model for the Removal of the Sanitary and Storm Sewers at Hunters Point Shipyard*, December 17, 2008. Below are excerpts from that memo:

    Section 2, Background, p.1-2: "Contamination . . . could have come from rework and repair of radioluminescent devices (Ra-226 and Sr-90), NRDL [Naval Radiation Defense Laboratory] experimentation and development of radiation survey instrumentation (Ra-226, Cs-137, and Sr-90), or decontamination of ships that participated in atomic weapons testing. . . . radiological operations at HPS started in 1941 and concluded in 1974 with the closure of the shipyard. During this time, controls of radioactive materials, particularly involving radioluminescent devices, were much more relaxed than today's standards and any radiological operation could have potentially impacted the sewer system. . . . Slip fittings were used at pipe joints of the sewer system, therefore the lines were not sealed and some leakage from the pipe was expected when the system was built. Additionally, excavated manholes have been found to be porous. The potential for materials to migrate from piping and manholes into the surrounding soils is significant."

    Section 3b., Conceptual Site Model, p. 2: "Historically, the systems were cleaned, repaired, and replaced as necessary. In addition to potential normal seepage, all three of these operations could have released contaminations [sic] into soils surrounding the systems. In fact, cleaning was often accomplished by power washing that could have forced the contamination from the system and in some cases leave the piping free of contamination but the surrounding soils contaminated. . . . Power washing of old sewer systems easily cracks the pipes and allows for releases of pipe sediment into surrounding soils."

    Section 3c. Conceptual Site Model, p. 3: "To date, the removal action has demonstrated the accuracy of the conceptual site model."

    Section 3d. Conceptual Site Model, p. 4, shows that as of December 9, 2008, the Navy found 6.9% of contaminated soil in Parcel B (including Parcel D-2) trenches and 12.2% of Parcel G. This represented 93.8% of the Parcel B trench units and 58.5% of the Parcel G trench units.

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Section 4a Ongoing Removal Operations, p. 5: "93.8 percent of the sewer survey units in Parcel B . . . demonstrates the validity of the CSM [Conceptual Site Model]. Most contamination has been found in the soils surrounding the pipes, primarily below five feet. This is consistent with the pipe locations and the fact that repairs to the system or power washing would have resulted in the spread of contamination well beneath and beyond the piping system."

EPA has also discussed site conditions with contractors that worked at Hunters Point and conducted oversight of removal action, and they provided the following information:

a. During three attempts by the Navy while the shipyard was still in use to separate the storm drains and sanitary sewer lines, soil from piping would have been excavated and piled up beside the trenches and then returned to trenches. As a result, it is not possible to predict where contamination would be in the vicinity of the storm drains and sanitary sewers.

b. It is also known that the sanitary sewers on Parcels G, D-1, and D-2 (formerly all part of Parcel D), and E were in very poor condition based on the large groundwater depression that formed in these areas. Groundwater entered the sanitary sewers through cracks and gaps in the piping. After the lift station pumping was terminated, it took many years for normal groundwater flow conditions to be established; remnants of this depression can be seen in Parcel E on the A- Aquifer groundwater elevation contour maps through November 2015. It is likely that differential settling and earthquakes caused the cracks and gaps in this system and that the storm drain system had similar cracks and gaps.

c. Furthermore, the seagates in the storm drain system did not work well. As a result, it is possible that incoming tides moved contaminated sediment inland into lines that would not have been expected to have been contaminated. Numerous Parcel B and G forms indicate that sufficient sediment was present to sample and count in some lines. When radionuclide contamination was found above cleanup levels, the Base-wide Radiological Work Plan required that the bottom of the trench be sampled. This occurred in some trenches.

d. Finally, much of the piping was found to be in poor condition and could not be removed intact from the SD/SS trench excavations. In some cases, the Parcels B and G forms note that there was shattered or broken piping. Any sediment in the bottom of this broken piping was likely mixed with the soil in the trenches, rather than being removed.

This Conceptual Site Model is the basis for selection in the Parcels B and G the Records of Decision (RODs) for Parcels B and G of alternative R-2, the Workplan that Tetra Tech EC, Inc., was required to follow, over alternative R-1, which was "No action." For Parcels B and G, no alternative between these levels of effort was analyzed. Please revise Section 2.1 to add more detail such as information in the above record about the Conceptual Site Model.

22. Section 2.3 Release Criteria: Regarding background, the 2008 Navy Memo cited in the previous comment states the following in Section 3e(2)(a), p. 4: "There is always the possibility of naturally occurring radioactive material (NORM), however the types of contamination found in the sewer excavations do not fit the profile of NORM. This has been carefully monitored by the Navy to ensure there is no need to change the CSM. One method in use is comparison of the Ra-226 activity with the U-238 activity. This is based on the assumption that when Ra-226 is naturally occurring it exists in equilibrium with U-238. Theoretically, if two isotopes are in secular equilibrium the activities should be the same and thus the ratio of the activities should be 1 to 1. If Ra-226 was introduced into an environment by a man-made device or a contamination event then the ratio of Ra-226 relative to U-238 should be biased high by the amount of Ra-226 deposited."

    Section 3e(2)(b), p. 4: "For Parcel B, . . . the U-238 activity was consistently lower than the Ra-226 activity by a significant margin. The U-238 activity ranged from 10 to 60 percent of the Ra-226 results. . . from the Parcel G . . . The U-238 activity were 30 and 50% of the Ra-226 results. These results would indicate that although there is some small amount of Ra-226 naturally occurring in the HPS [Hunters Point Shipyard] soil the bulk of the Ra-226 activity was introduced by man-made sources. Based on the U-238 to Ra-226 ratios at Parcels B and G, the current CSM for HPS is correct and the majority of radioactive materials at the base is from man-made sources, and is not NORM."

    Section 5a(4) Summary: "The analysis of the Ra-226 and U-238 ratios for in [sic] Parcel B pipe sediment indicate the presence of radium contamination not the possibility of higher levels of naturally occurring radioactive material"

    Please revise Section 2.3 to include the information above to be consistent with the Navy's record about naturally occurring background.

23. Section 2.4 Anomalous Soil Samples Report. This work represents the only resampling of potentially falsified data from Tetra Tech EC, Inc., that has been conducted to date. That report stated for Building 517 Survey Unit 2, "The systematic sample results [from resampling] are substantially more elevated than the anomalous [previously reported] set of systematics, suggesting that the anomalous set of systematic samples is not representative of its respective survey unit." (p. ES-4). Please summarize the extent to which the new results from resampling exceeded the results originally reported, which were potentially falsified. For example: What percentage of the new results exceeded the previously reported results? By how much? At how many locations did the new results from sampling exceed the release criteria? What percentage of the total exceedances did that represent? Also, please add that concentrations above the release criteria were found during resampling, as new excavations were conducted in five locations base wide.

ED_002138A_00011220-00015

24. Section 2.5 Former Worker Allegations. Please add language that states that former workers alleged that Tetra Tech EC, Inc. generally tried to under-represent the true extent of exceedances of cleanup levels in its falsification activities. Please note in the report that the Navy, EPA, DTSC, and CDPH reviews of this report have found examples of data patterns that would be consistent with these allegations. Please also note in the report that all the worker allegations listed in this section already would suggest that if sampling been performed according to the original work plan using the original analytical methods, more evidence of contamination could have been found than was originally presented.

25. Section 3 Data Evaluation Activities. The data evaluation of buildings found duplication of data, which confirms one of the allegations from a former worker. It is possible that duplication of data occurred in soil data as well. Please describe the Navy's efforts to search for evidence of duplication in soil data, including both gamma scan and laboratory data. Please also note what aspects of soil data the Navy did not search for duplication and explain why these data were not searched for duplication.

26. Section 4 Findings and Recommendations. See attached summary Tables 1 and 2 that combines the recommendations for resampling for trench, fill, and building site survey units for Parcels B and G, respectively. Please note that for both Parcel B and Parcel G, the EPA found significant similarities in the types of signs of falsification in survey units that the Navy recommended for resampling and those designated "No Further Action" by the Navy. EPA, DTSC, and/or CDPH recommended all of these survey units for resampling.

27. Section 4.1.1 Parcel B Trench Units. EPA has reviewed Trench Unit forms that were labelled "no further action" in the draft. An attached spreadsheet shows the detailed review. The review did not find the magnitude of patterns of falsification found in Parcel G. However, the review did find more data quality issues with negative values and on-site versus off-site differences, which adds to some of the variability and "breaks" in slopes on the Q-Q plots. Of the 66 trench units that the Navy recommended for "No Further Action," a quarter of them had missing gamma scan and static data and 9% showed differences in weight between samples sent to the onsite vs. offsite lab. Here are examples of other patterns observed in multiple trench units:

    - Bi-214 Final Status Survey (FSS) results (and often Ac-228 and K-40 as well) have low variability. This observation could be a sign of sample substitution or biasing samples to areas with known low activity.
    - Gamma static data has low range. This observation could be a sign that the meter was kept in one place.
    - Gamma static data inconsistent with Gamma scan data and FSS data
    - Q-Q plots indicate multiple populations
    - Many other concerns were found through data evaluation, and most trench units showed red flags of multiple types.

ED_002138A_00011220-00016

28. Section 4.1.2. Parcel B Fill Units. The Navy recommended resampling Trench Unit 057. Therefore these fill units that received fill from this suspect source should have correspondingly been recommended for resampling: OB206, OB219, OB222, and OB223. In addition, the USEPA, the DTSC, and CDPH analysis found more trench units that showed concerns and recommended those for resampling. Therefore the regulatory agencies have concluded that an additional 84 fill units require resampling because of a suspect source. These are listed in Spreadsheet 6 in the Parcel B workbook. Out of the remaining ten fill units, five show signs of falsification and/or data quality concerns. Please see Spreadsheet 5 in the Parcel B Workbook showing analysis of these ten remaining fill units. A total of 107 out of 112 fill units are therefore recommended for resampling.

29. Section 4.1.3. Parcel B Current and Former Building Sites. The CDPH has reviewed survey units in building sites and has recommended resampling all units except Building 157, Survey Unit 7. EPA has conducted an independent review of this analysis and concurs with it. In addition, please note that Building Site 157, SU7, was a class 2 survey unit. The plots show some anomalies, Bi-214 FSS_SYS had low variability, there were slope breaks in the K-40 FSS_SYS data set, and low variability was noted for the gamma statics (about 1200 counts per minute [cpm]). However, any contamination in this area is more likely associated with Trench Units 50 and 50A (which cross through SU 7) and was addressed separately, so contamination in SU 7 is less likely. CDPH recommends SU 6 for resampling, and SU 7 surrounds SU 6. If contamination is found in SU 6, then SU 7 should become a Class I SU. Since it was previously a Class 2 SU, it would have to be rescanned and sampled according to the Class 1 criteria.

30. Section 4.2.1. Parcel G Trench Units. In Parcel G, in nearly a third of all 63 Parcel G trench units, post remediation gamma scans indicated a need for biased samples to be collected, but they were not. Out of the 43 trench units that the Navy designated for "no further action:"
    - Over half had inconsistencies between gamma scan and static data and over one-third had other types of inconsistencies (e.g. on-site and off-site results differ by more than 10X, plots showed signs that multiple populations likely in the data set, etc.)
    - In a third, the narrow range of gamma static data indicates measurements were not collected from different locations as required.
    - In six, some data were missing so some evaluations could not be done.
    - In a few trench units, biased sample results appeared lower than other data sets, which is the opposite of what we would expect. And in a few more, the Navy's report described a finding of potential falsification in one aspect of the work but still did not flag for resampling.
    - Many other concerns were found through data evaluation, and most trench units showed red flags of multiple types.

31. Section 4. Findings and recommendations. The review looked for both signs of falsification and signs of data quality concerns. A survey unit sometimes shows signs of

ED_002138A_00011220-00017

one or the other or both or neither. One of the tabs in the attached spreadsheets for Parcels B and G separates the findings for these categories for each survey unit.

SPECIFIC COMMENTS

1. Executive Summary: At the beginning, please add the time-period and number of the soil data points being reviewed by this investigation for each parcel. The Navy could move the first sentence under Parcel B on page iii and the first sentence of Parcel G on page iv to this area. The community wants to know up front the number of data points reviewed.

2. Executive Summary: Please reference the site maps in the summary that are within the report body. Maps give the reader clarity when discussing areas of concern. In addition, the maps need to be enlarged to be viewed by the myopic eye.

3. Executive Summary: Please move the "Assumptions and Uncertainties" explanation from the end of the summary to the beginning so the reader has this foremost in their mind. It gives them clarity as to why the Navy made certain decisions about the investigation.

4. Executive Summary: In the last paragraph on page i, please add, … "TtTec conducted rework at each of the survey units identified (in parcel C and E) …

5. Executive Summary: Delete the Parcel B and Parcel G Graphs – they do not support the summary nor give any relevant clarity to the reader.

6. Executive Summary: Add to the titles on page iii and iv, Parcel B Recommendations and Parcel G Recommendations.

7. Executive Summary, Parcel G, first bullet, Page iv: The first bulleted item on page iv states that there was evidence of potential data manipulation or falsification in twenty trench units, whereas the remaining forty-three of sixty-three units did not have such evidence. However, there are numerous Data Evaluation Forms provided by the Navy that identified some form of falsification (e.g., TU 97), but then proposed no action. If all of the Data Evaluation Forms that mention alleged falsification associated with activities for each trench unit are counted, there would be more than twenty in total. Please revise this bulleted item to include a tally of all of the Trench Units where data manipulation or falsification was noted in the Data Evaluation Forms.

8. Section 2.1, p. 2-2, paragraph 5 states "If Cs-137 results from the onsite laboratory were at or above the release criteria, isotopic plutonium, isotopic uranium, and Sr-90 were also analyzed by the offsite laboratory." Was this checked as a part of the investigation? If it was not followed this would be another instance of not following the work plan.

9. Section 2.1, Page 2-2, paragraph 3: Suggest deletion of the last sentence since it is subjective. "At this stage, nearly all radioactive contamination is expected to have been removed. Surveying and sampling of the soil above and below the piping was a conservative measure implemented by the Navy. "

ED_002138A_00011220-00018

10. Section 3.0, Graphical Data Review, Page 3-3: The symbols used on the box plots should be explained in the text. Additionally, it is unclear how uncertainty associated with the collection of radiological data was addressed on the box plots (i.e., whether it was considered). The text should also explain how "bias" and "characterization" samples coordinate with the labels used in the current FRED database built by the Navy. Please revise the Report to address these concerns.

11. Section 4.3, Page 4-34: The text states," The sampling program should be based on the findings of this report and consider that naturally occurring Ra-226 may exceed the release criterion without being indicative of site-related contamination." This statement should be deleted since the purpose of performing the analyses was to ensure that the ROC concentrations remaining onsite are below the agreed upon release criteria.

12. Appendix C: For the next Parcels to be evaluated, we suggest that you only plot the off-site laboratory data on the box plots and Q-Q plots to eliminate that source of variability in the reviews.

MINOR COMMENTS (e.g., suggestions for clarity in wording)

1. Executive Summary: On page i, paragraph three, sentence three, change "…were purported to..." to "…were reported to…"

2. Executive Summary: One page i, paragraph three, sentence five, there is an end quotation, but no beginning quotation mark from the TtTec's report. If sentence five is not a direct quote from TtTec's report, please change "…persons listed as the sample collectors,…" to "…employees listed as sample collectors,…"

3. Executive Summary, Page i first bullet of allegations: Here is suggested rewording for clarity: When soil concentrations were expected to be above release criteria, soil samples were collected from a different area known to have lower radioactivity. These samples were incorrectly reported as having come from the original location.

4. Executive Summary, Page ii 3rd bullet. Here is suggested rewording: During the screening of overburden soil, actual towed array scan speeds were greater than allowed speeds. The lower speed reduced the probability of radiation detection and reduced the likelihood of meeting required detection limits.

5. Executive Summary, Page ii last paragraph last sentence. Based on General Comment 2, it is inconsistent to use the term "No Further Action." Here is suggested rewording: "Based solely on a review of the data previously collected by Tetra Tech EC, Inc., and the findings of the data evaluation, recommendations are provided for resampling in some survey units where data revealed concerns." Please delete mention of archived samples for the reasons listed in General Comment 3.

ED_002138A_00011220-00019

6. Section 1.1 Objective: Suggested rewording: The objective of this evaluation is to review and assess the historical radiological data collected by TtEC at HPNS and recommend follow-up data collection needed to ~~validate~~ evaluate the current radiological conditions and whether release criteria have been met regarding the property identified in this report.

7. Section 2.1, p. 2-2, last paragraph suggested rewording: "If peripheral soil was identified above the release criteria, it was processed as low-level radioactive waste (LLRW), it was disposed of, and the trench segment where the peripheral soil originated was sampled in 3-foot intervals to determine the extent of potential contamination.

8. Table 2-1 says "TtEC. 2011. *Survey Unit Project Reports Abstract, Sanitary Sewer and Storm Drain Removal Project, Hunters Point Shipyard, San Francisco, California, Revision 3.* July 7. YYYY." The year should be included.

9. Section 2.4 Anomalous Soil Samples Report, Page 2-4, second to last sentence: Here is suggested rewording: " indicating that the corrective actions had addressed the problem." Ultimately, TtEC conducted rework at each of the survey units identified. However, in the following years, former workers at HPNS alleged additional and more widespread data manipulation and falsification, which have been substantiated by this investigation report.

10. **Section 2. Radiological History**

    - Bullet 1: define "Triple A"
    - Paragraph 2: Suggest additional langue: Release criteria were discussed and agreed upon by the Navy and regulatory agencies. Areas where low-level radioactive contaminants were addressed, through radiological removal actions by TtEC, include the following:

ED_002138A_00011220-00020

Table 1

EPA, CDPH, and DTSC review of Parcel B Rad Data Evaluation

	Trench	Fill	Building Sites	Total	% of total
Tota Survey Units in Parcel B	70	112	17	199	100%
Navy recommended resampling	2	18	9	29	15%
Navy recommended reanalyzing archived samples	2	1	0	3	2%
EPA, CDPH, DTSC recommend resampling	55	89	7	151	76%
Total recommended resampling	57	107	16	180	90%
No signs of falsification found in data	13	5	1	19	10%
Regulators not yet reviewed	0	0	0	0	0%
% of total recommended resampling	81%	96%	94%	90%	

The above was for Parcel B alone. Below is for entire Shipyard.

Total Survey Units in Hunters Pt Tetra Tech EC	*305*	*514*	*
Parcel B as % of total	23%	22%	*

* Parcel B has 7 former building sites, which is 21% of the total 34. The above chart shows survey units at building sites. The number of survey units at building sites for the entire site was not available.

ED_002138A_00011220-00021

Table 2

Summary of EPA, DTSC, CDPH review of Parcel G Radiological Data Evaluation

	Trench	Fill	Building Sites	Total	% of total
Total Survey Units in Parcel G	63	107	32	202	100%
Navy recommended resampling	20	53	25	98	49%
EPA, CDPH, DTSC recommend resampling	39	54	5	98	49%
Total recommended resampling	59	107	30	196	97%
No signs of falsification found in data	4	0	2	6	3%
% of total recommended resampling	94%	100%	94%	97%	

The above was for Parcel G alone. Below is for entire Shipyard.

Total Survey Units in Hunters Pt Tetra Tech EC	*305*	*514*	*
Parcel G as % of total	21%	21%	*

* Parcel G has 4 former building sites, which is 12% of the total 34. The above chart shows survey units at building sites. The number of survey units at building sites for the entire site was not available.

ED_002138A_00011220-00022

ATTACHMENT 1

EPA Review Guidelines for Parcel G Forms, Plots, and Data

Flag in Plots

- Box plots
  - Significantly different populations; look at variability of range for each radionuclides provided
  - Biased lower than the others, would expect biased to be similar to or higher than systematic.
- Q-Q plots - Slope break, sometimes flatter, sometimes steeper, which would be sign of different populations; slopes should be similar for various scan types of each radionuclide (not necessarily for K-40)

Flag in forms

- Multiple rounds of excavations
- Gamma scan or static not provided or range less than 2,000-3,000 counts per min; Scan and statics not consistent (one example showed a range of 2,900 to 9,400 which is normal)
- Off site and on-site lab results significant difference, e.g. > 2X
- Time Series – Time series show anomalies or missing time series, e.g. S024, Cs-137 was remediated but graphs not provided

Other – Open-ended: anything else that looks noteworthy

Enter into Review Spreadsheet:

- Sign of falsification? 1=yes, 0=no, plus add summary of why
- Failure to follow workplan? 1=yes, 0=no, plus add summary of why
- Level of concern/need for resampling
  - 2=high level of concern, e.g. yes signs of potential deliberate falsification found, > 2-3 red flags from above
  - 1= need further review, e.g. no sign of potential deliberate falsification, some uncertainty due to missing or unclear information, 1 red flag found
  - 0=low, e.g. nothing noteworthy observed
- Comments – Other – anything not already covered elsewhere
- Followup research questions? Do we need more info from Navy to make determinations?

ED_002138A_00011220-00023

ATTACHMENT 2

EPA Supplemental Statistical Analyses for Parcel B Trench Units 56, 61, 131, and 186

PARCEL B – TU 56

Survey- Date -Lab	Number of Samples
fss-bias 06_22_2007 false	18
ras 06_22_2007 false	2
fss-bias 6_23_2007 false	8
fss-bias 06_25_2007 false	24
ras 06_25_2007 false	3
ras 07_19_2007 false	15
ras 08_07_2007 false	12
ras 08_20_2007 false	6
fss-bias 08_28_2007 false	3
fss-sys 09_08_2007 false	19
fss-sys 09_08_2007 true	2

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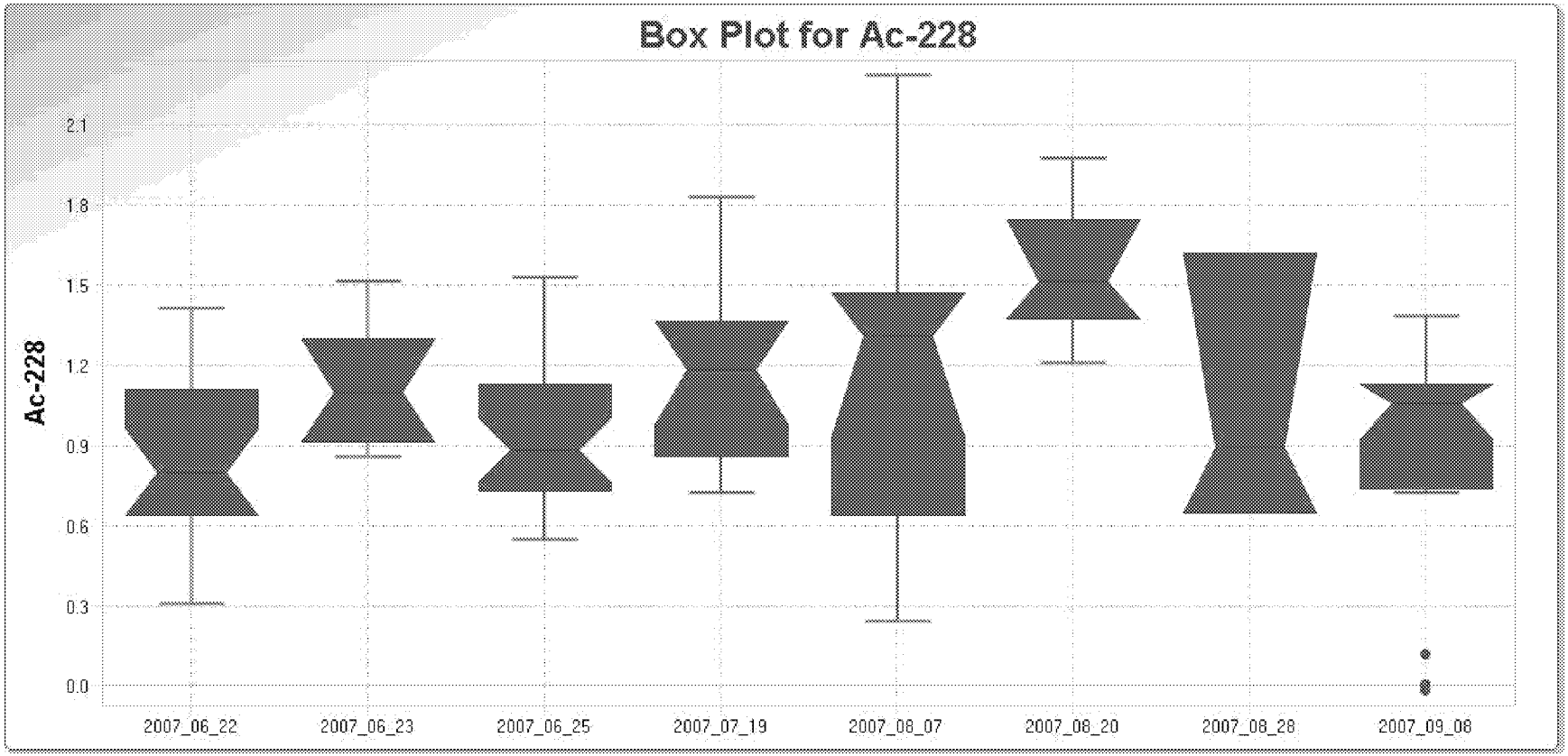
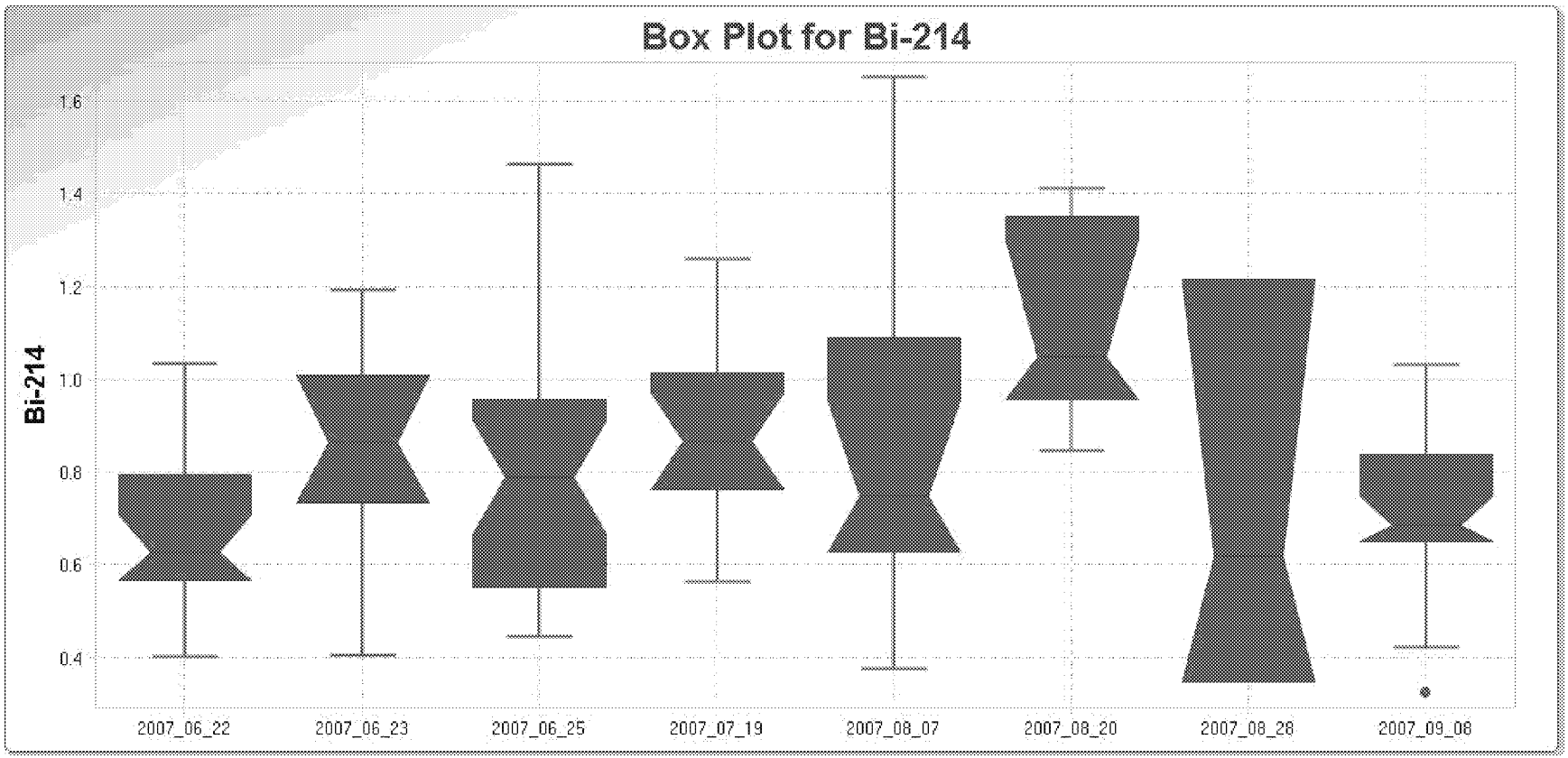

Box Plot for Ac-228
Ac-228
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
2007_06_22
2007_06_23
2007_06_25
2007_07_19
2007_08_07
2007_08_20
2007_08_28
2007_09_08


Box Plot for Bi-214
Bi-214
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1.4
1.2
1.0
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0.4
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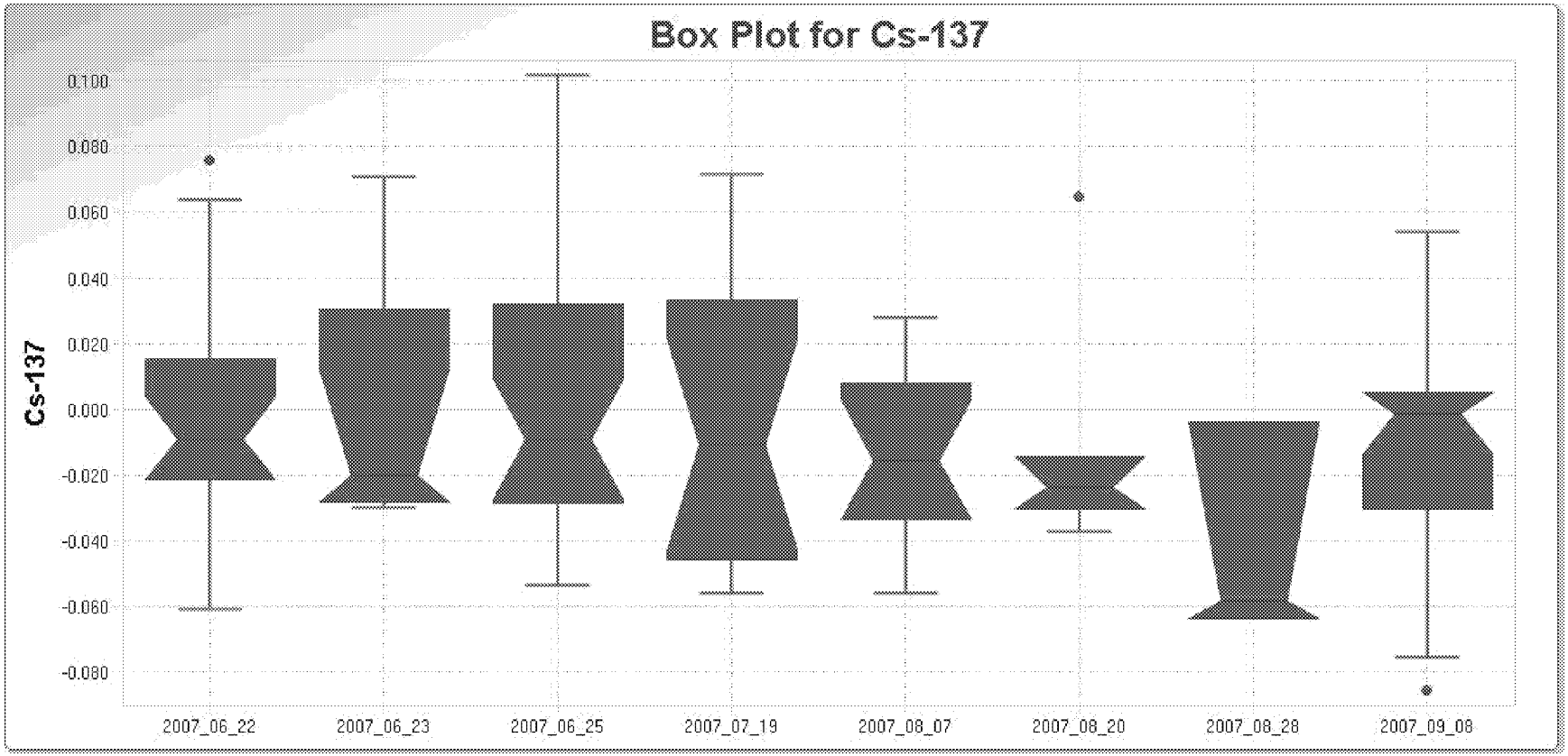
2007_08_28
2007_09_08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0.060
0.040
0.020
0.000
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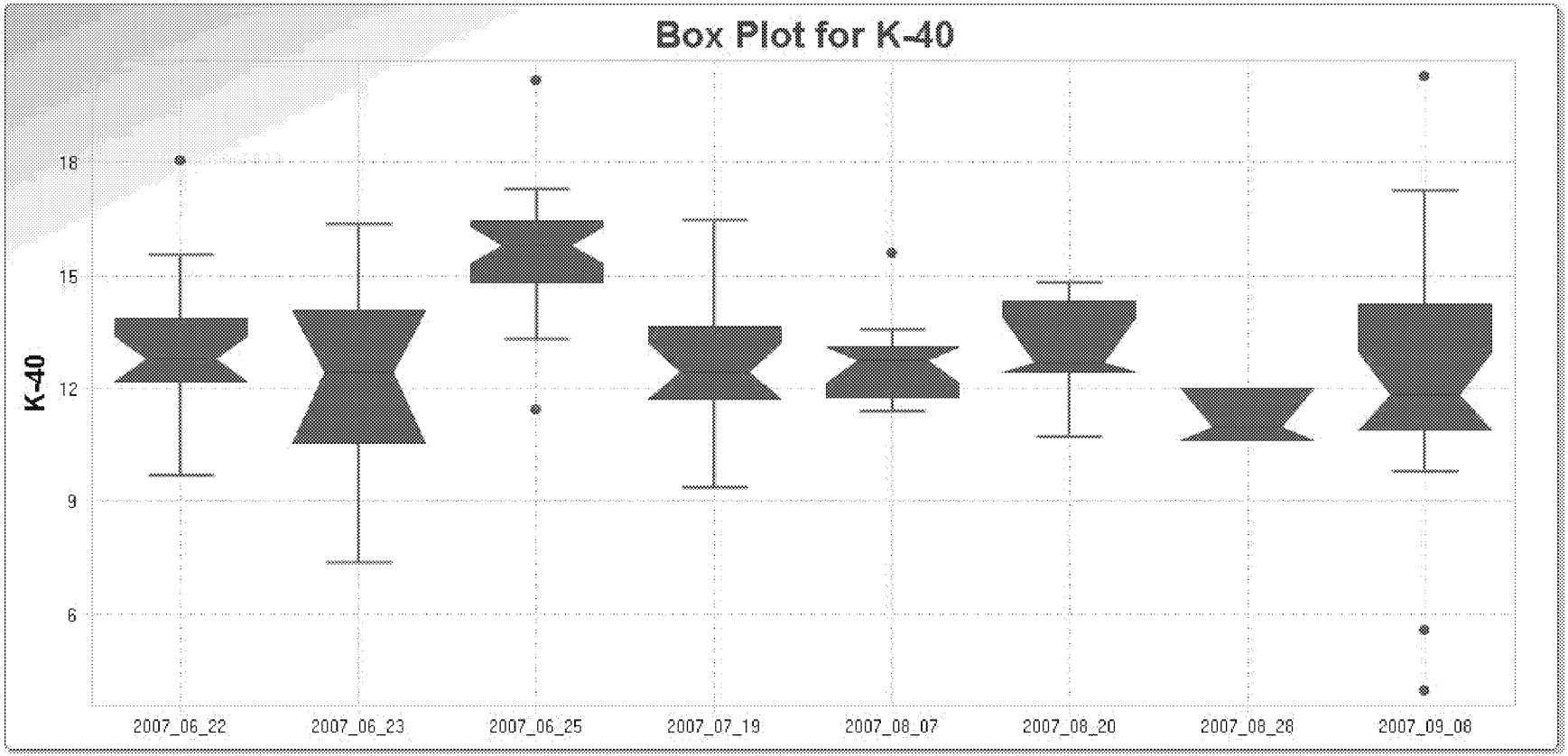
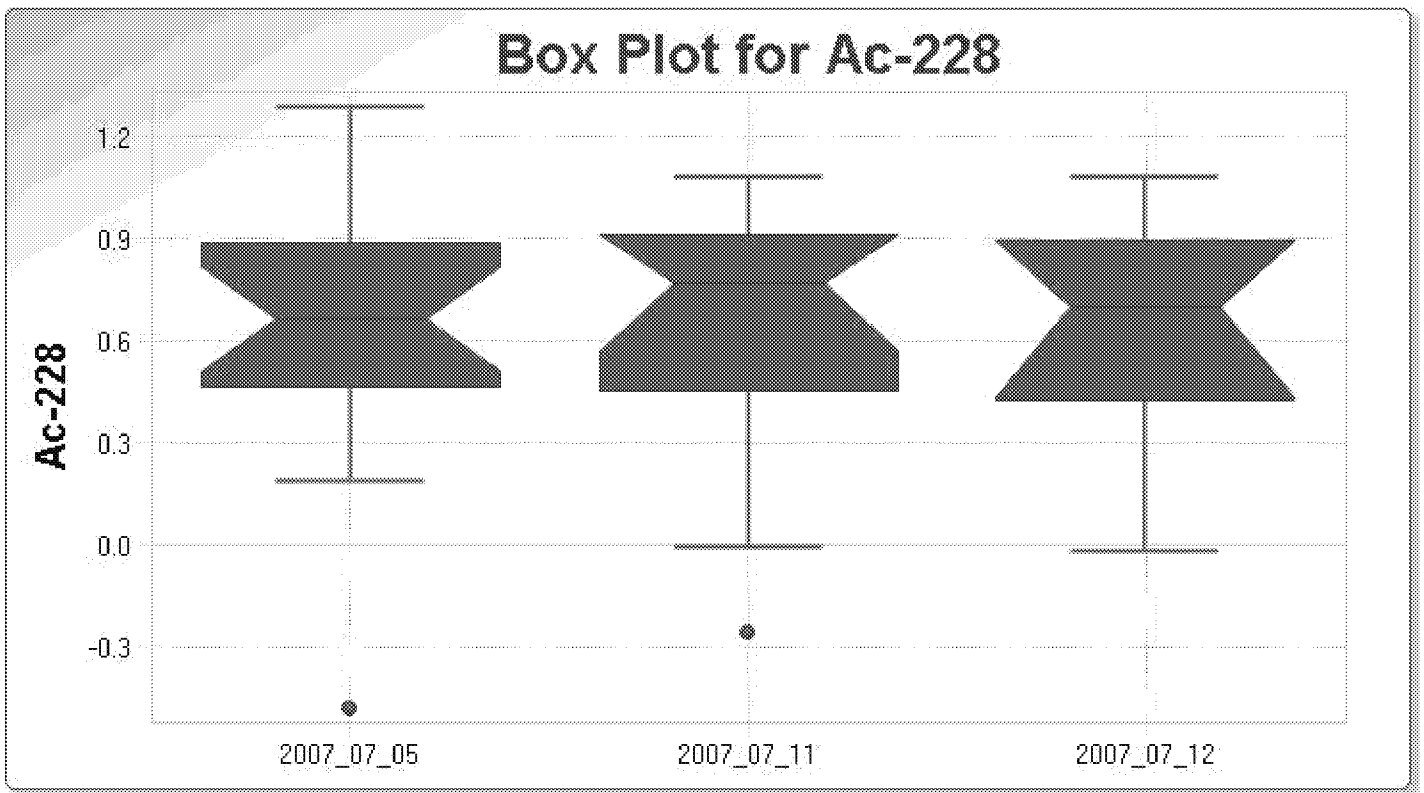
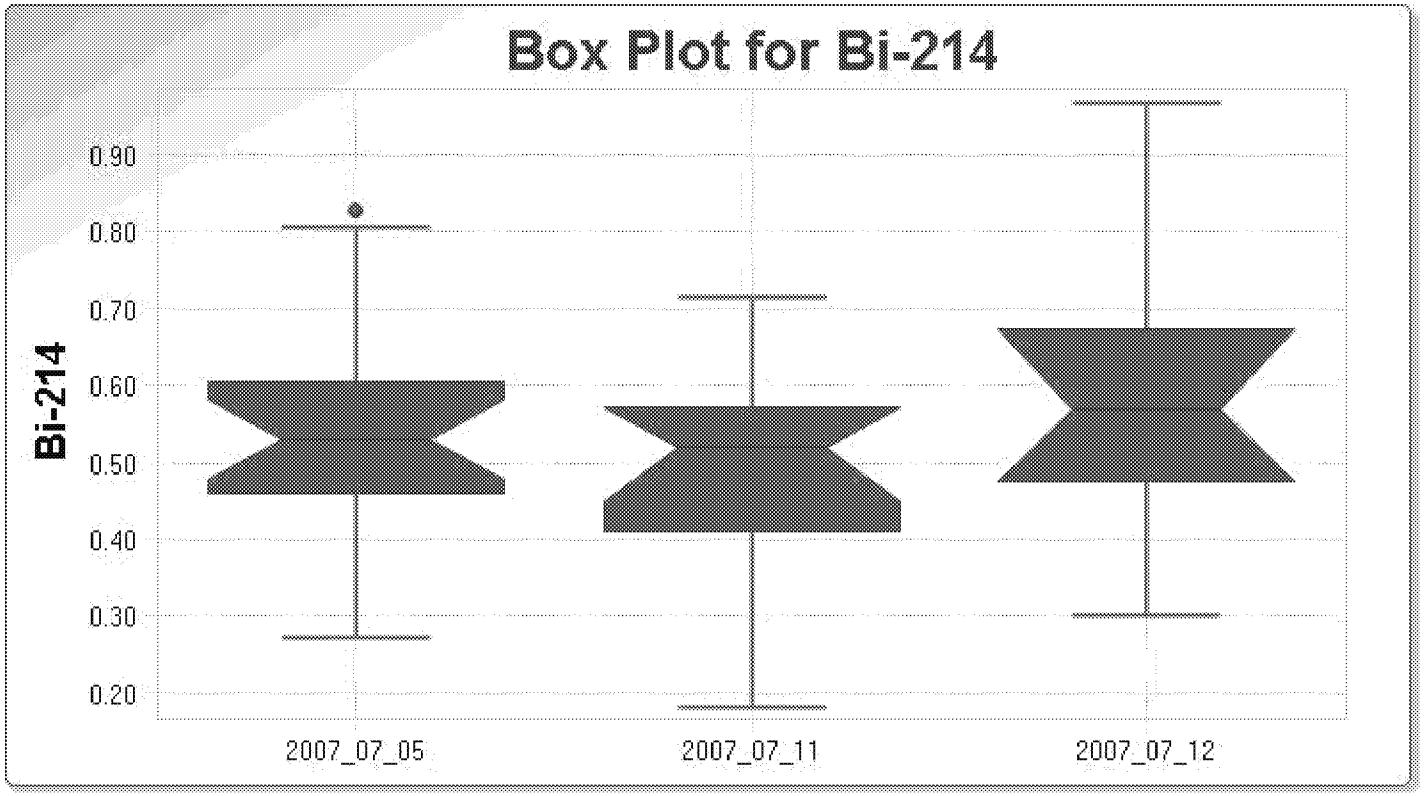
2007_06_22
2007_06_23
2007_06_25
2007_07_19
2007_08_07
2007_08_20
2007_08_28
2007_09_08


Box Plot for K-40
K-40
18
15
12
9
6
2007_06_22
2007_06_23
2007_06_25
2007_07_19
2007_08_07
2007_08_20
2007_08_28
2007_09_08

PARCEL B – TU 61

Survey- Date -Lab	Number of Samples
fss-bias 07_05_2007 false	19
fss-sys 07_11_2007 false	11
fss-sys 07_11_2007 true	2
fss-sys 07_12_2007 false	8




Box Plot for Bi-214
Bi-214
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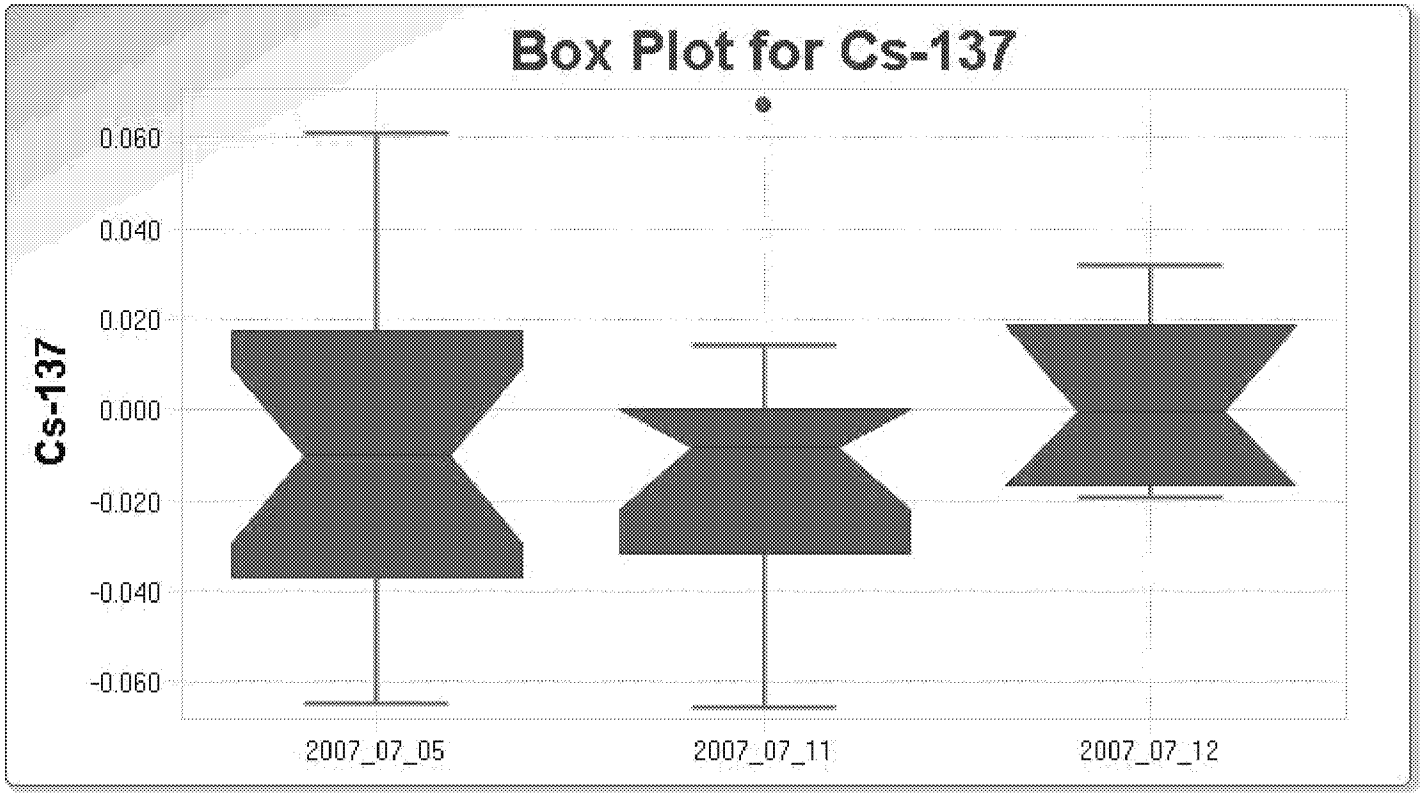
0.50
0.40
0.30
0.20
2007_07_05
2007_07_11
2007_07_12


Box Plot for Cs-137
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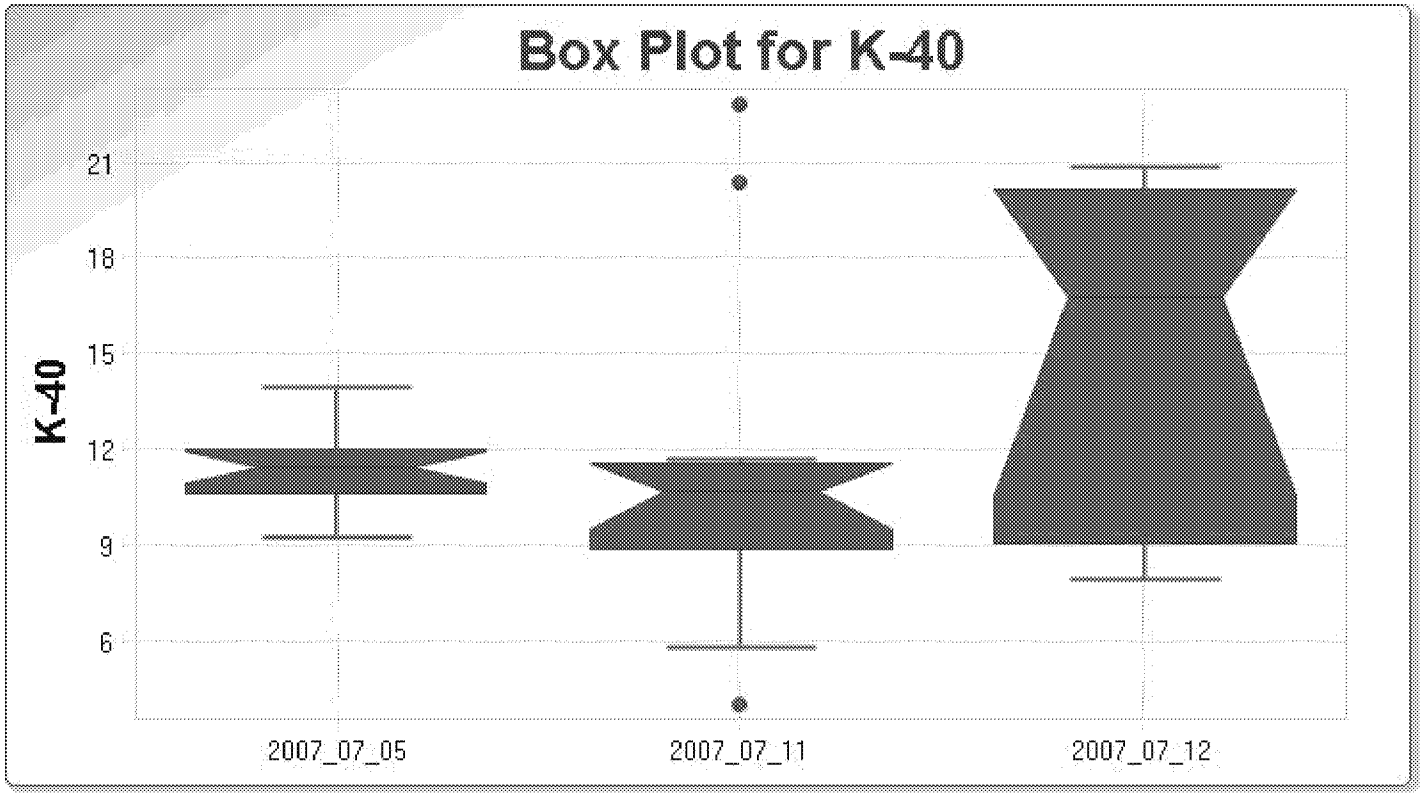
2007_07_11
2007_07_12



*The 2 high values on July 11, 2007 are duplicate samples collect as FSS-SYS. The low value is a sample analyzed on-site.

PARCEL B – TU 131

Survey- Date -Lab	Number of Samples
sys_1 05_08_2009 false	19
sys_1 05_08_2009 true	2
fss-bias 05_22_2009 false	3
fss-sys 05_28_2009 false	19
fss-sys 05_28_2009 true	3

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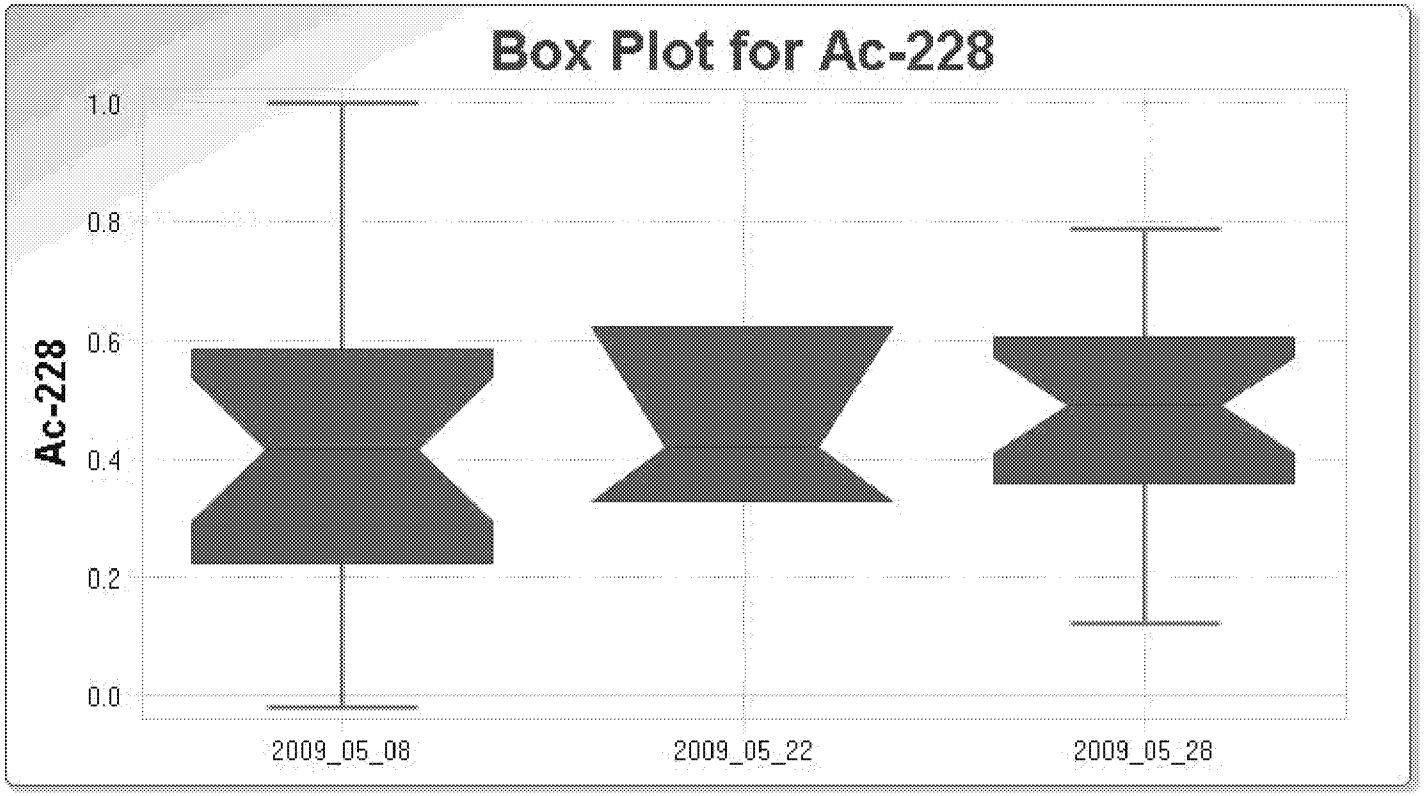
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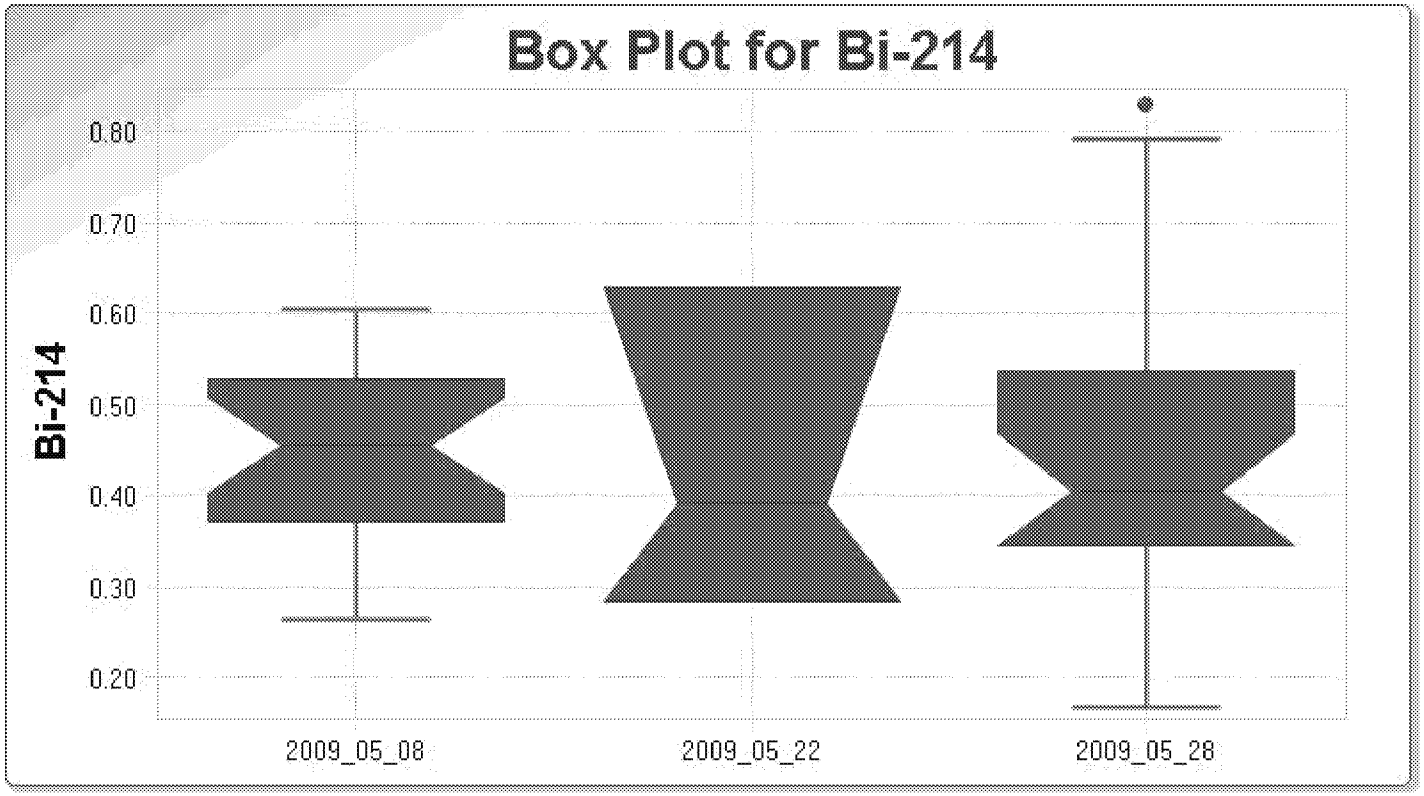
0.6
0.4
0.2
0.0
2009_05_08
2009_05_22
2009_05_28


Box Plot for Bi-214
Bi-214
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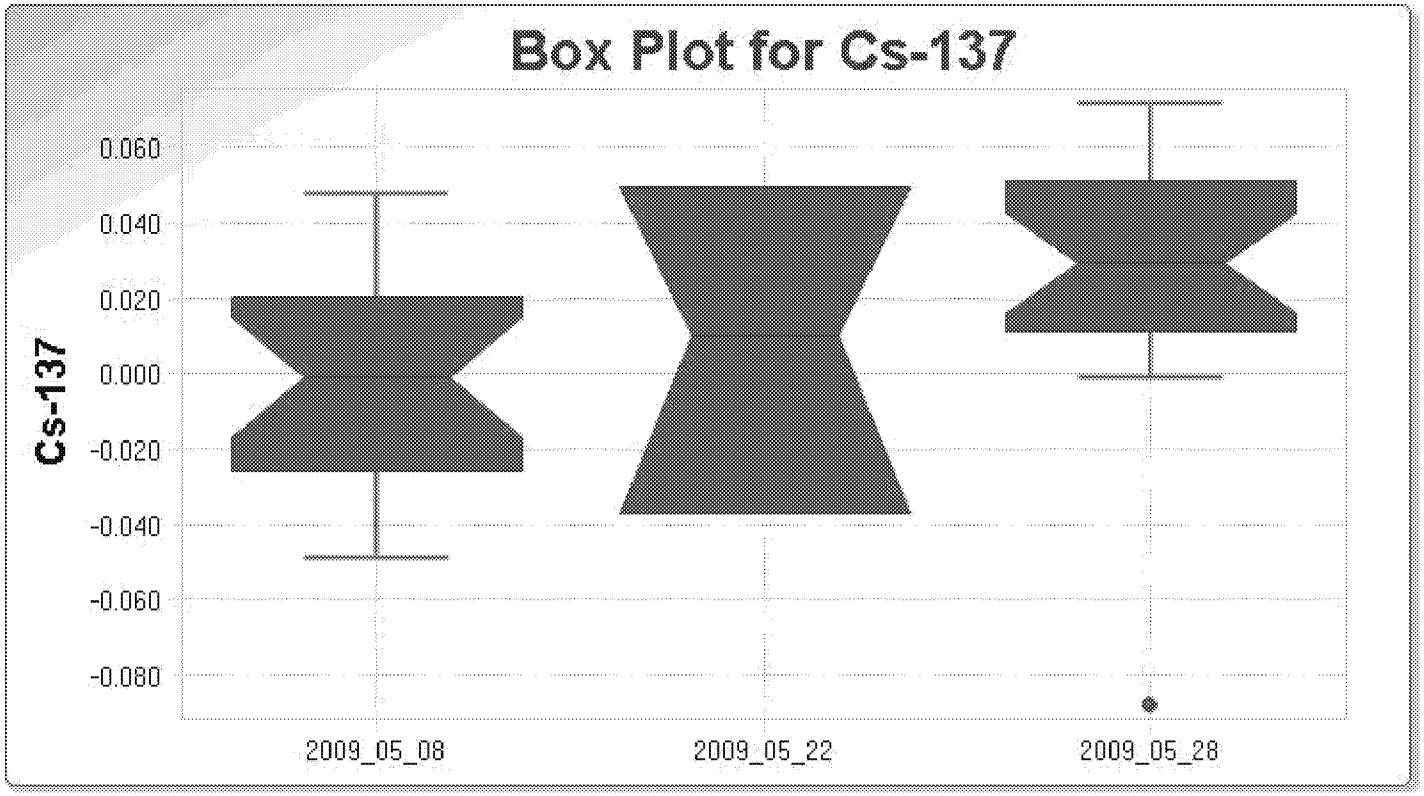
0.60
0.50
0.40
0.30
0.20
2009_05_08
2009_05_22
2009_05_28


Box Plot for Cs-137
Cs-137
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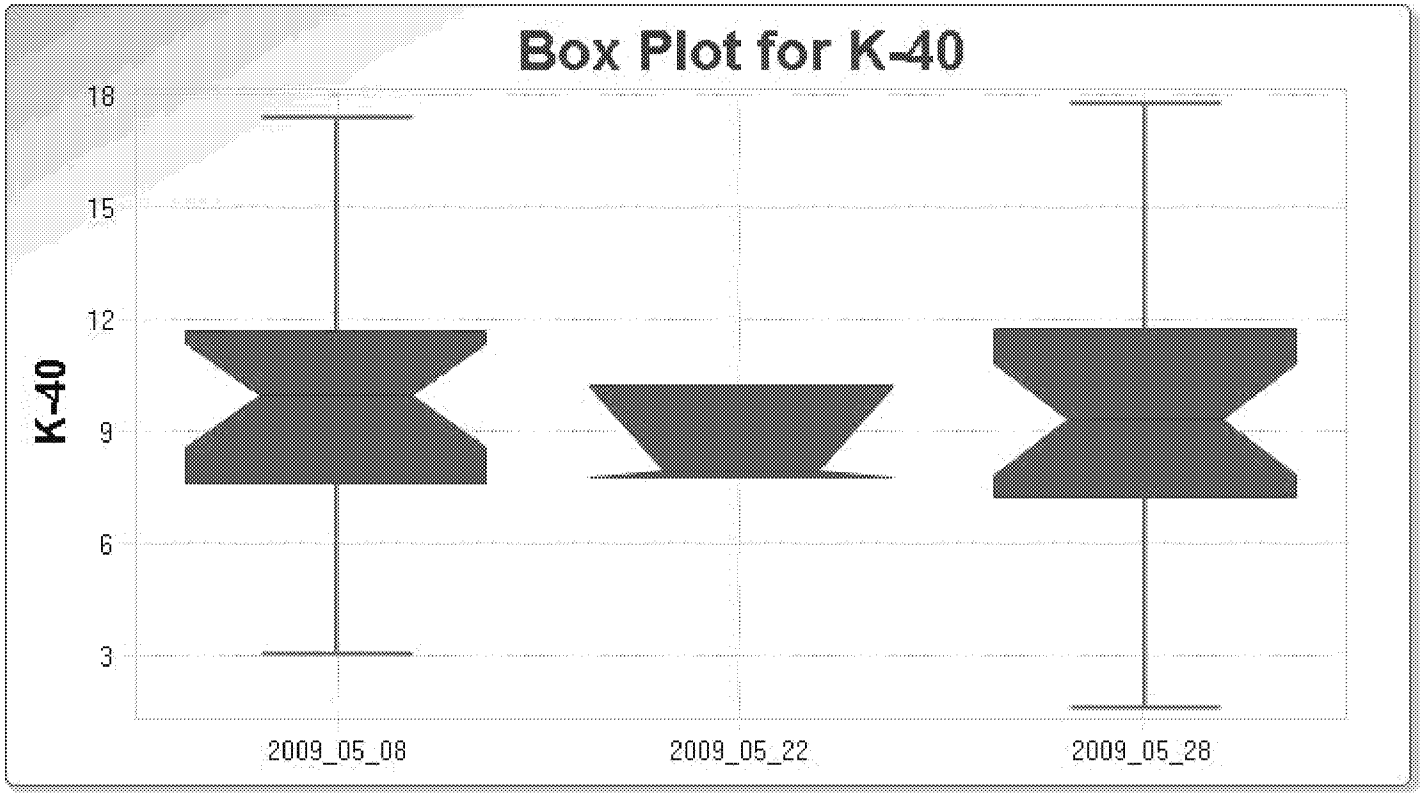
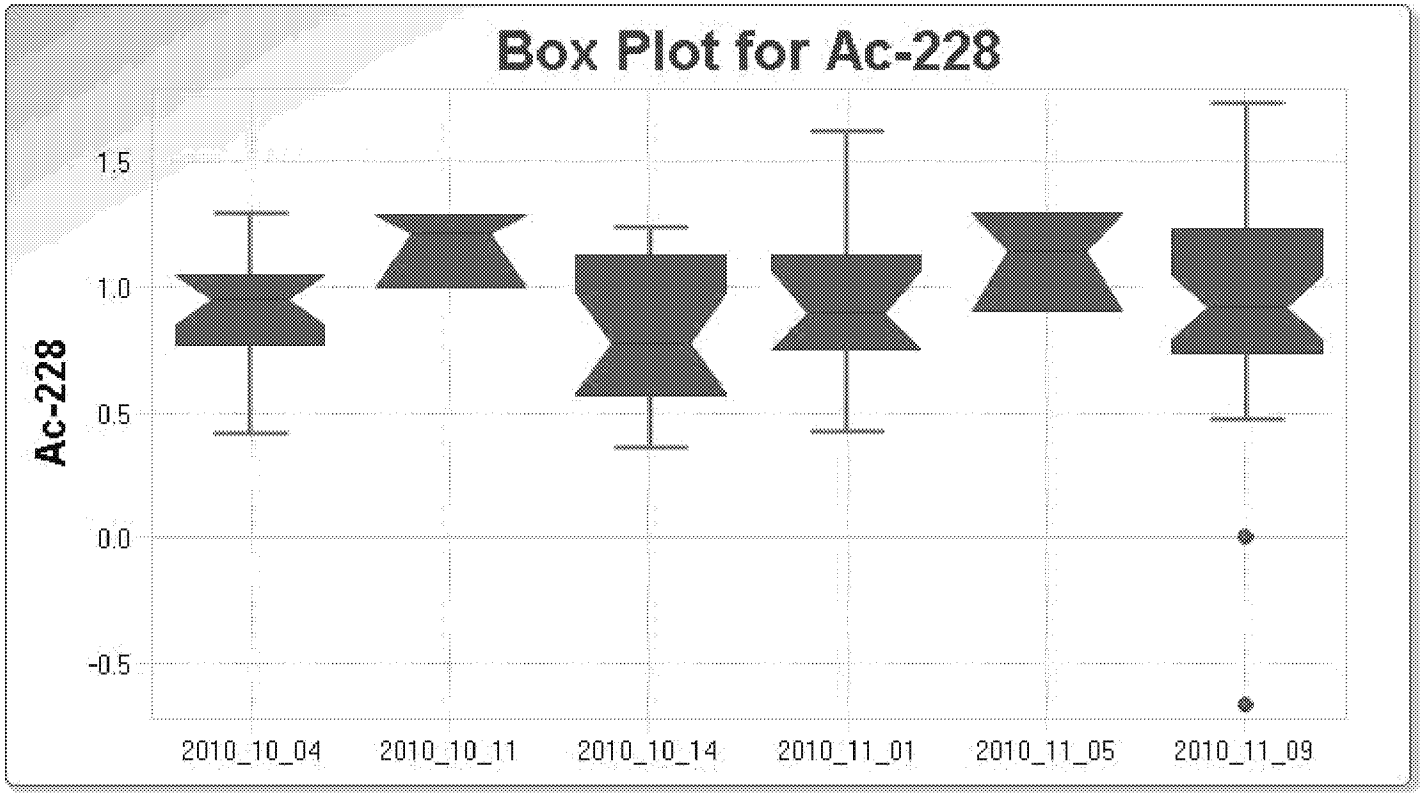
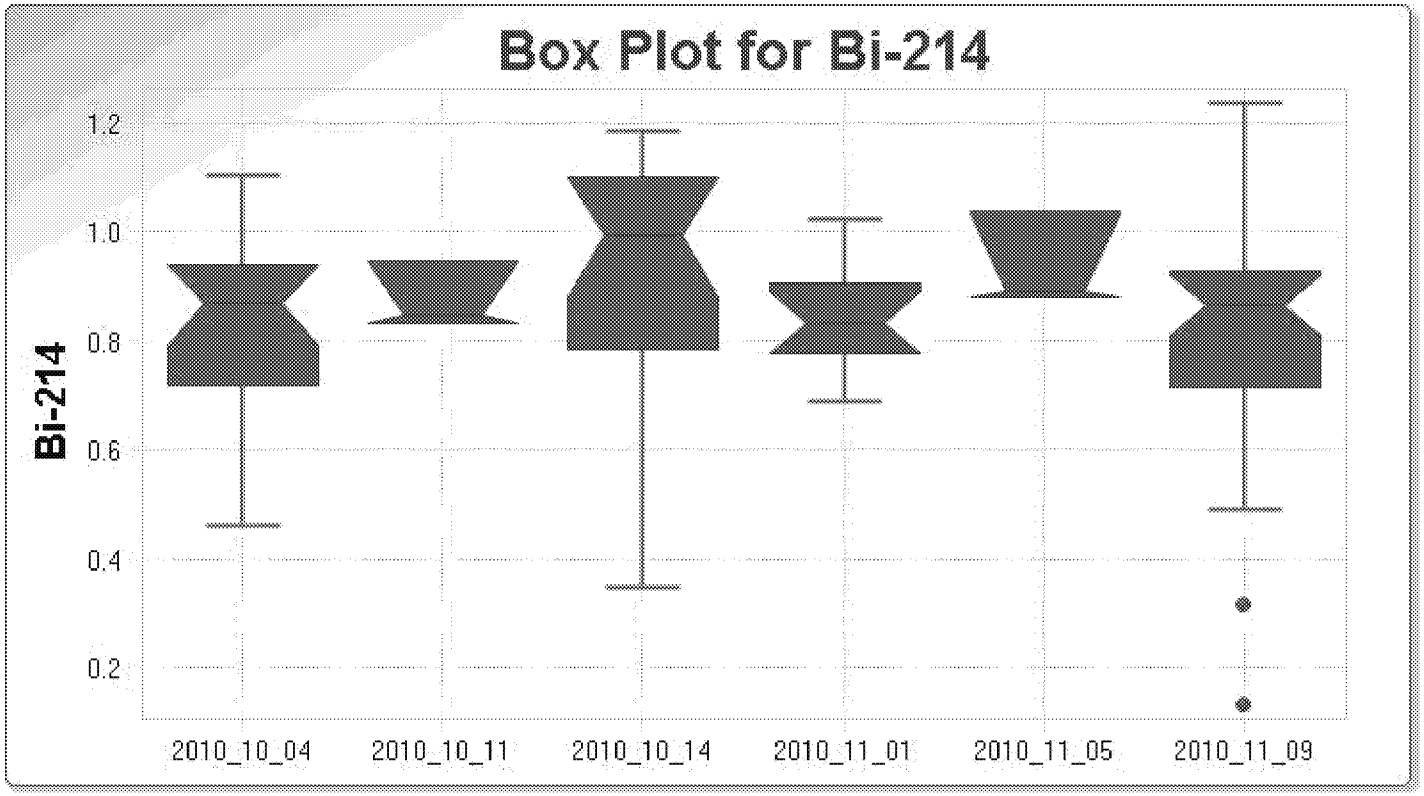
0.040
0.020
0.000
-0.020
-0.040
-0.060
-0.080
2009_05_08
2009_05_22
2009_05_28

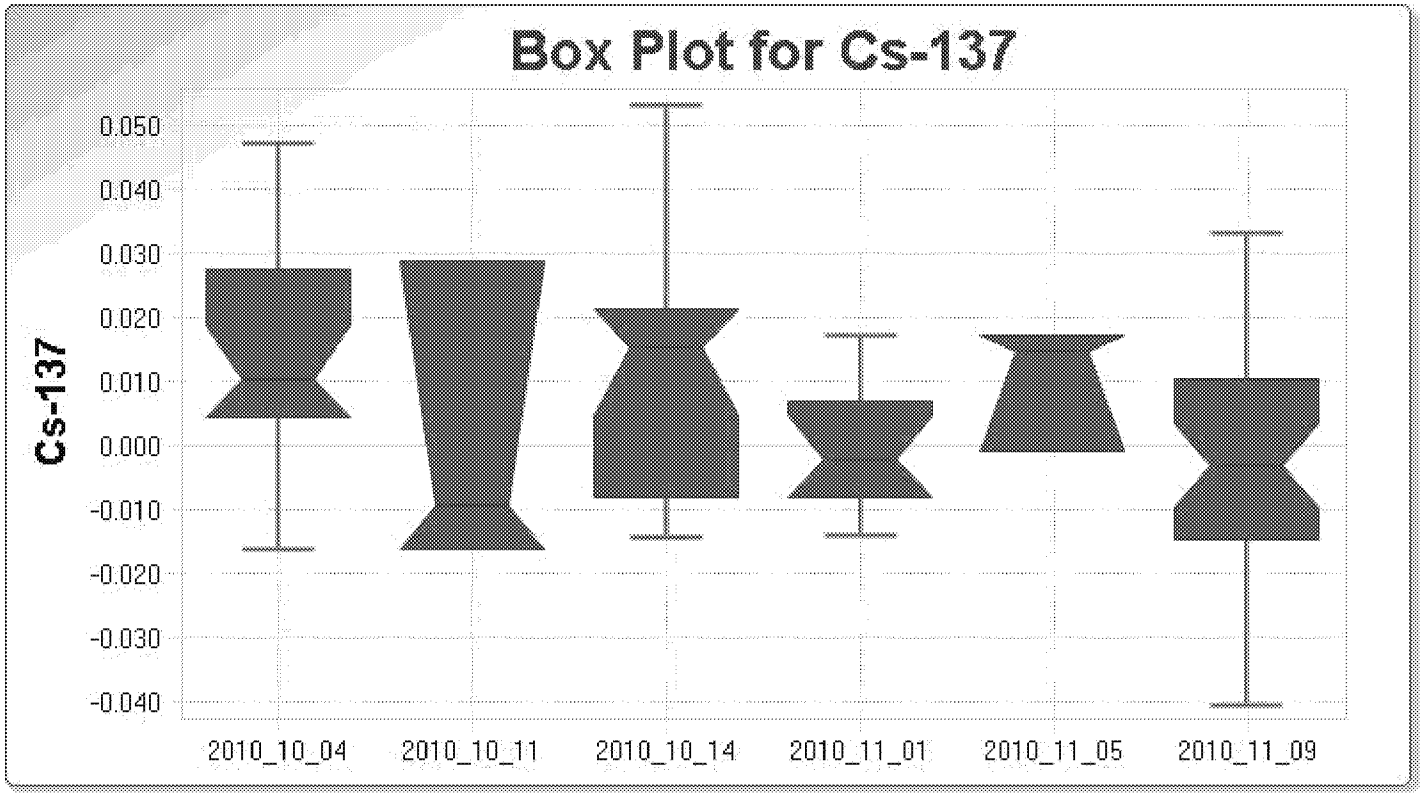

Box Plot for K-40
K-40
18
15
12
9
6
3
2009_05_08
2009_05_22
2009_05_28

PARCEL B – TU 186

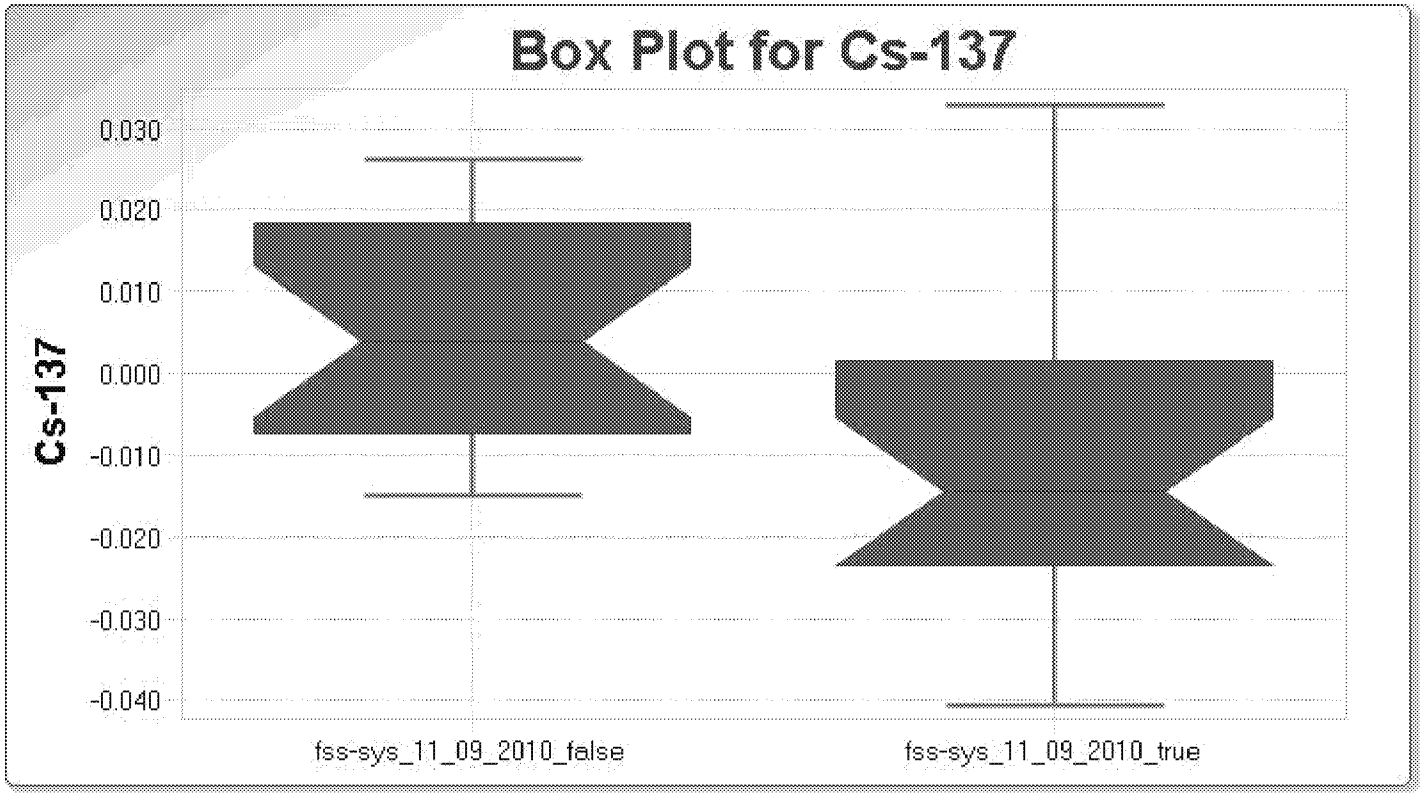
Survey- Date -Lab	Number of Samples
sys_1 10_04_2010 false	19
sys_1 10_14_2010 false	19
fss-bias 10_11_2010 false	3
ras 11_01_2010 false	12
fss-bias 11_05_2010 false	3
fss-sys 11_09_2010 false	19
fss-sys 11_09_2010 true	19

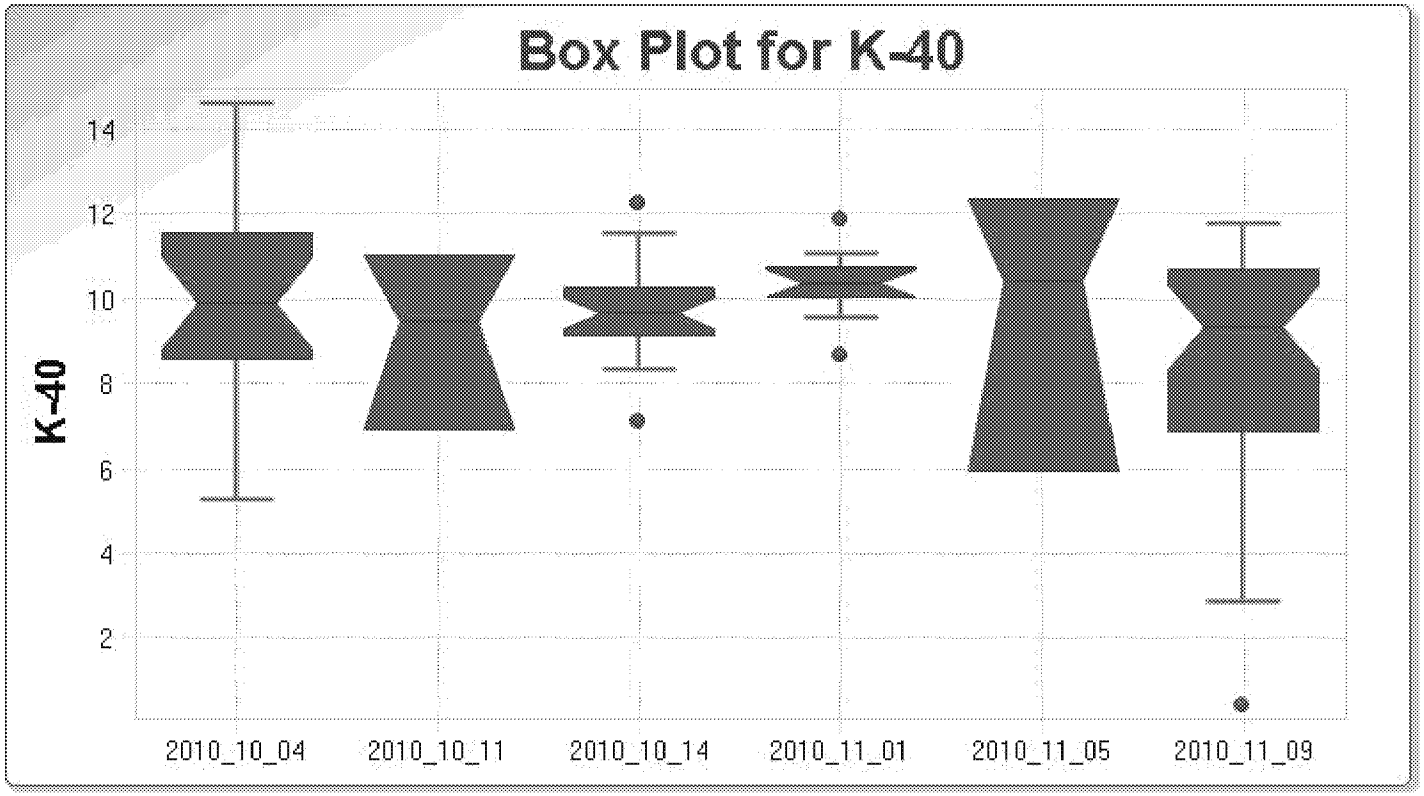

Box Plot for Ac-228
Ac-228
1.5
1.0
0.5
0.0
-0.5
2010_10_04
2010_10_11
2010_10_14
2010_11_01
2010_11_05
2010_11_09


Box Plot for Bi-214
Bi-214
1.2
1.0
0.8
0.6
0.4
0.2
2010_10_04
2010_10_11
2010_10_14
2010_11_01
2010_11_05
2010_11_09



Note: Wide spread for 11/09/2010 – examining data shows 19 samples for on-site analysis and 19 samples for off-site analysis. Prompted me to explore the spread by breaking out the two types of analyses. Figure below shows the on-site analysis resulted in lower results explaining the presence of the spread in the plot above. The off-site analysis shows similar variability to the other 5 events.


Box Plot for Cs-137
Cs-137
0.030
0.020
0.010
0.000
-0.010
-0.020
-0.030
-0.040
fss-sys_11_09_2010_false
fss-sys_11_09_2010_true


Box Plot for K-40
K-40
14
12
10
8
6
4
2
2010_10_04
2010_10_11
2010_10_14
2010_11_01
2010_11_05
2010_11_09

ATTACHMENT 3

EPA Supplemental Statistical Analyses for Parcel G Trench Units 73, 75, 82, 91, and 121

ED_002138A_00011220-00044

Parcel G S0073

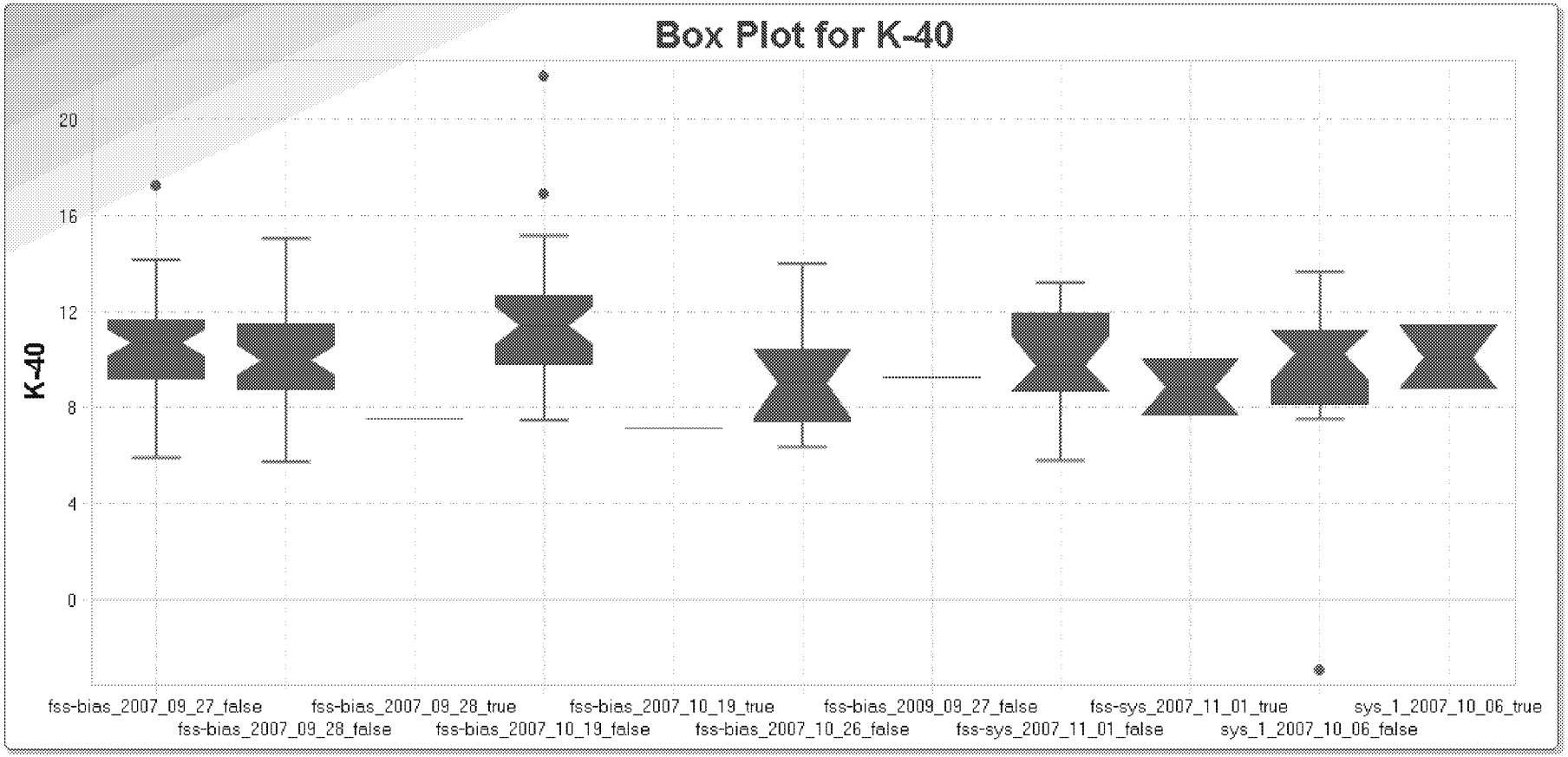
True = Off-site lab result

False= On-site lab results

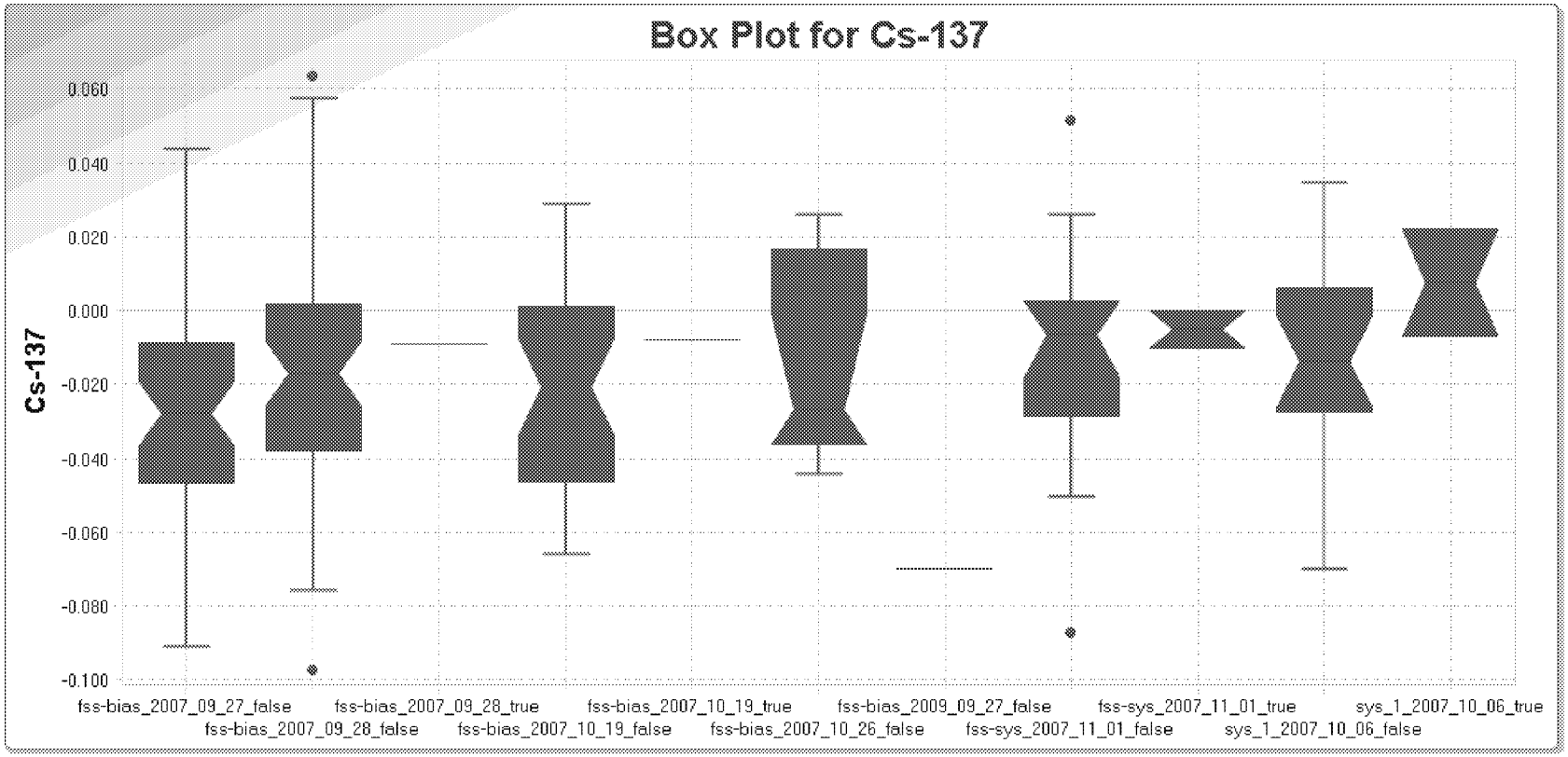
Dates are in the format: year_month_day

Variable	NumObs
fss-bias_2007_09_27_false	47
fss-bias_2007_09_28_false	49
fss-bias_2007_09_28_true	1
fss-bias_2007_10_19_false	32
fss-bias_2007_10_19_true	1
fss-bias_2007_10_26_false	10
fss-sys_2007_11_01_false	18
fss-sys_2007_11_01_true	2
sys_1_2007_10_06_false	18
sys_1_2007_10_06_true	2
fss-bias_2009_09_27_false	1

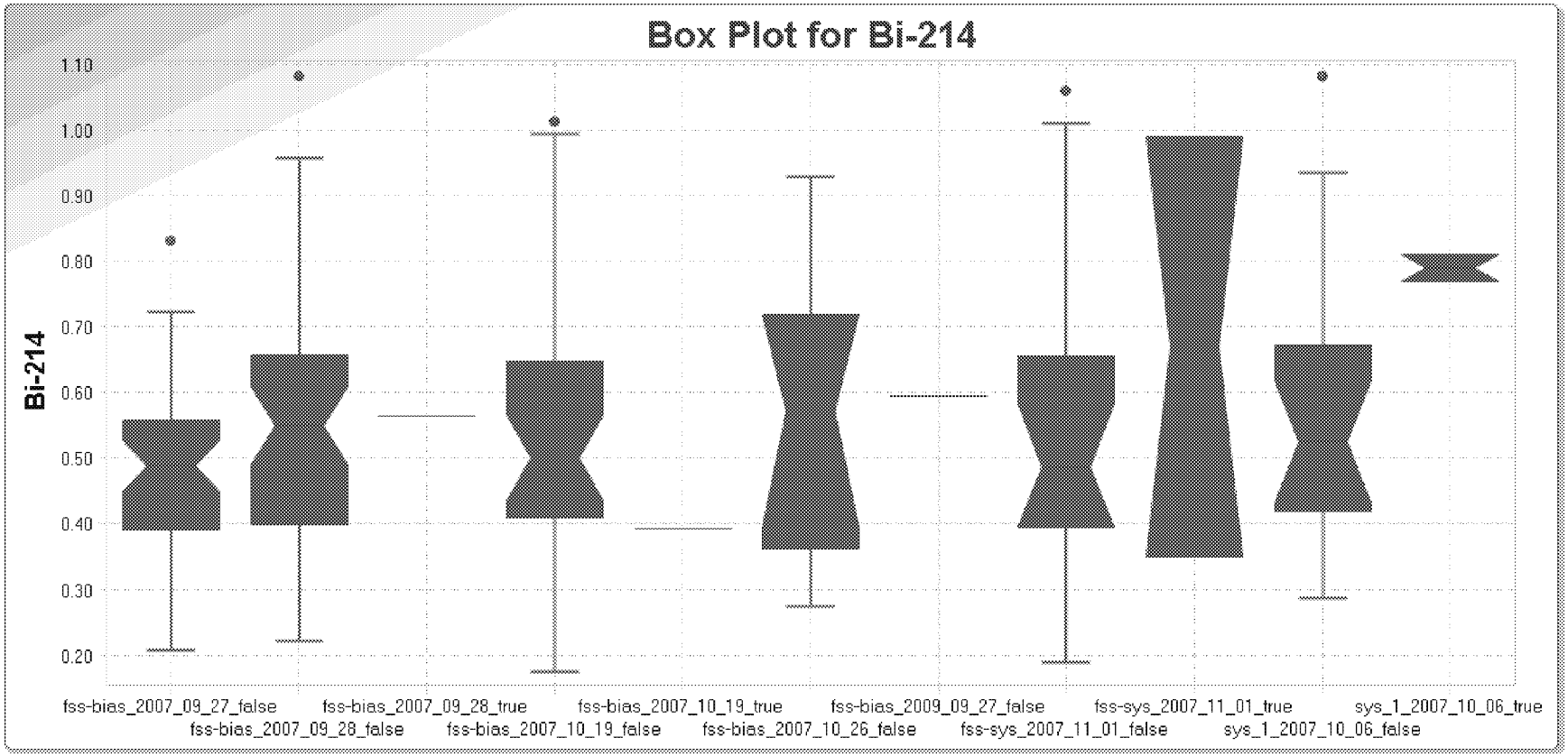
Parcel G – S0073



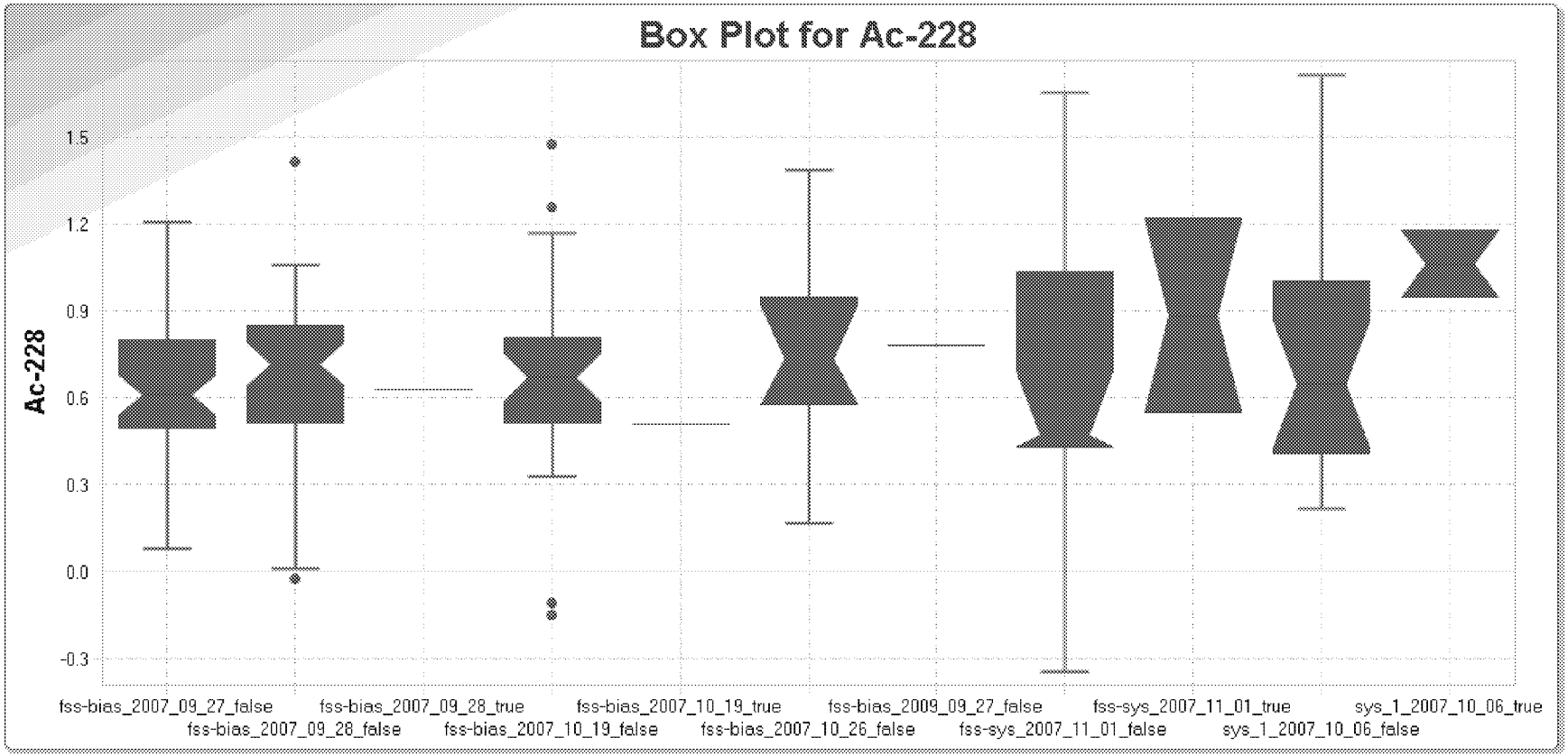
Parcel G – S0073



Parcel G – S0073



Parcel G – S0073



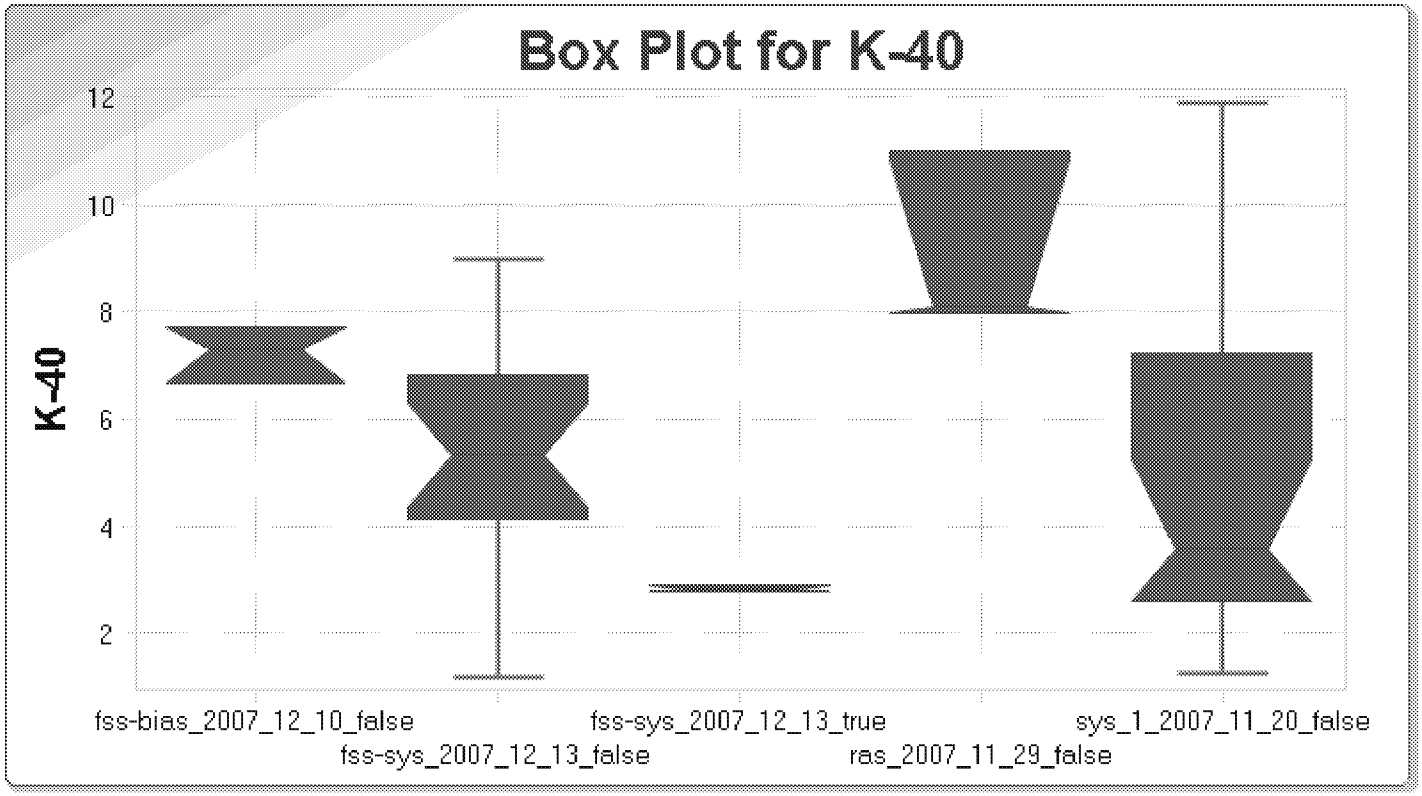
Parcel G S0075

True = Off-site lab result

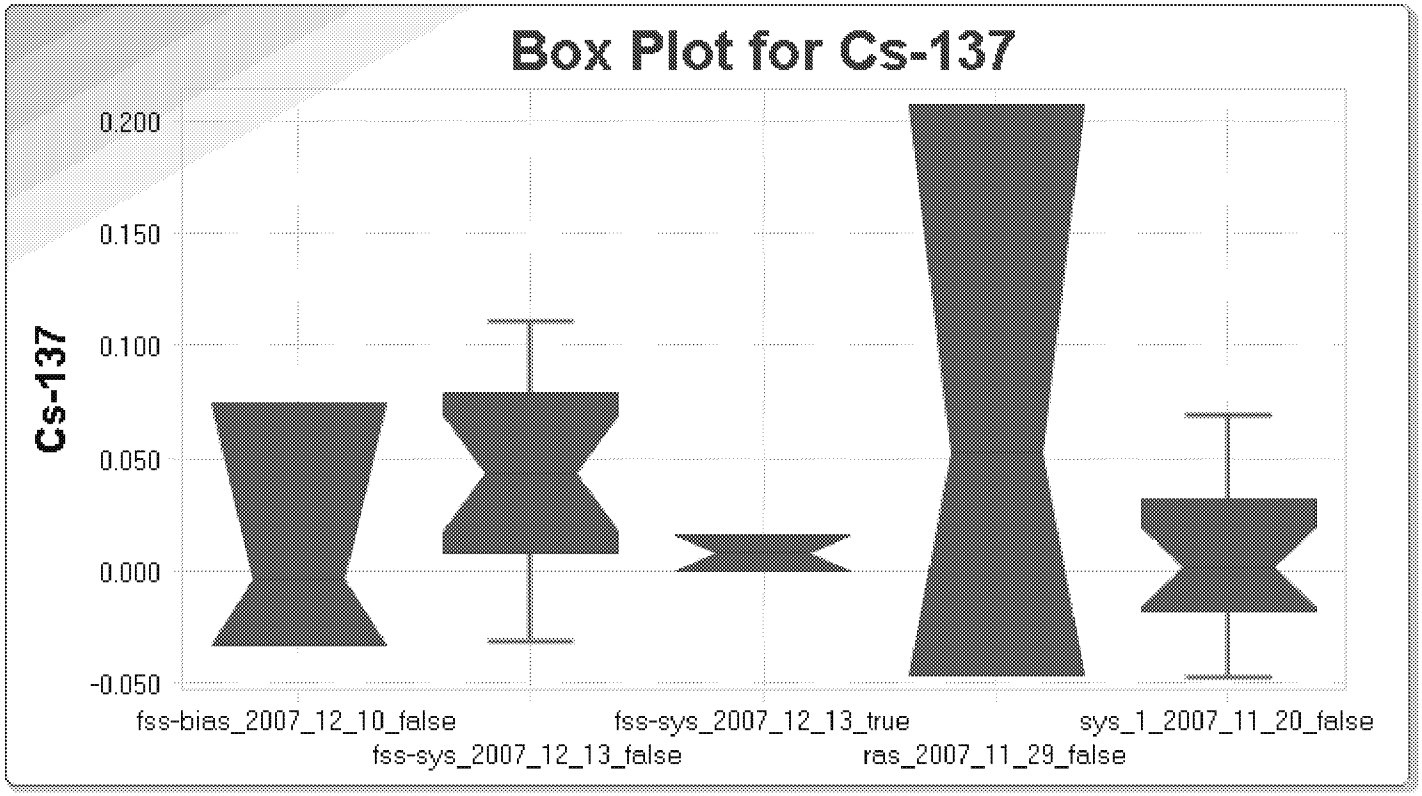
False= On-site lab results

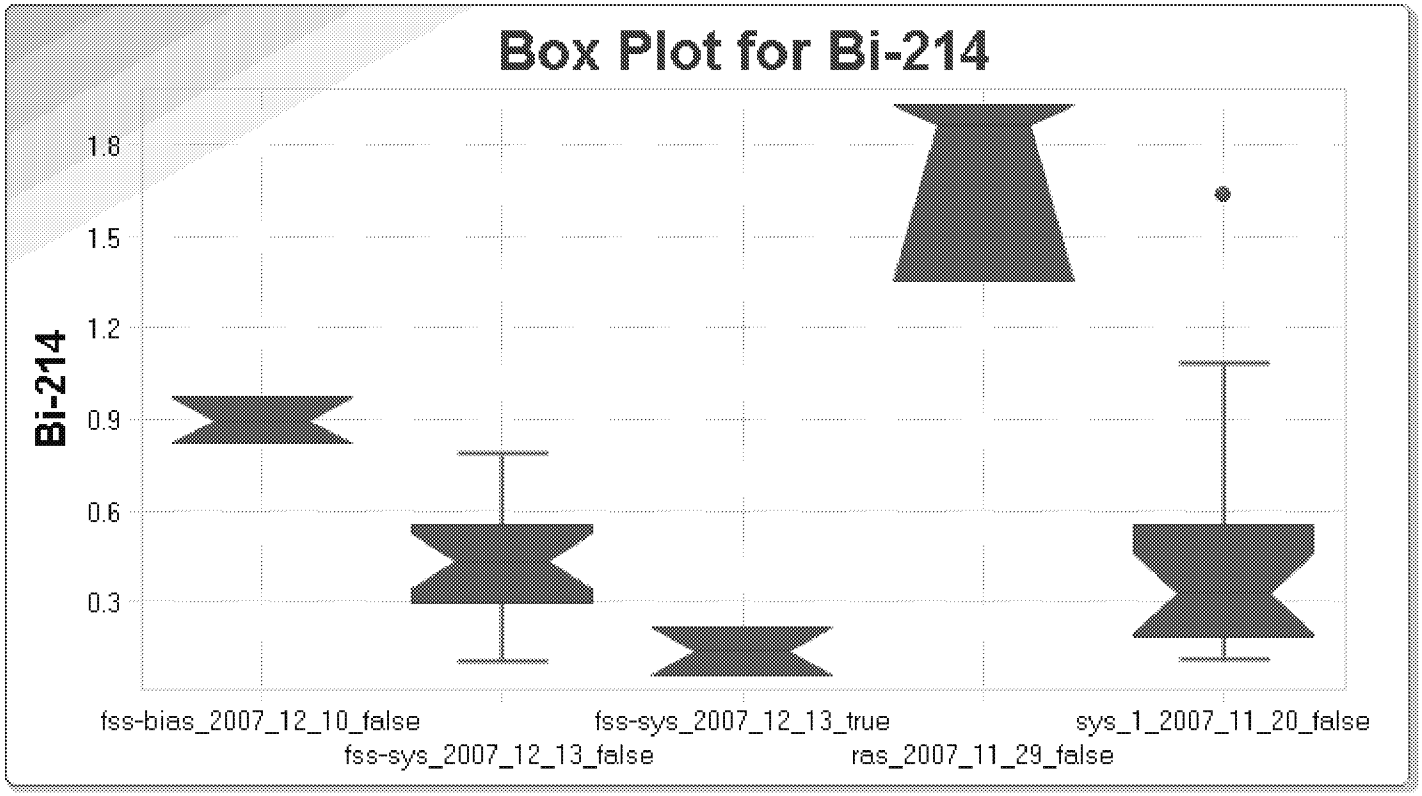
Dates are in the format: year_month_day

Variable	NumObs
sys_1_2007_11_20_false	19
ras_2007_11_29_false	3
fss-bias_2007_12_10_false	3
fss-sys_2007_12_13_false	19
fss-sys_2007_12_13_true	2

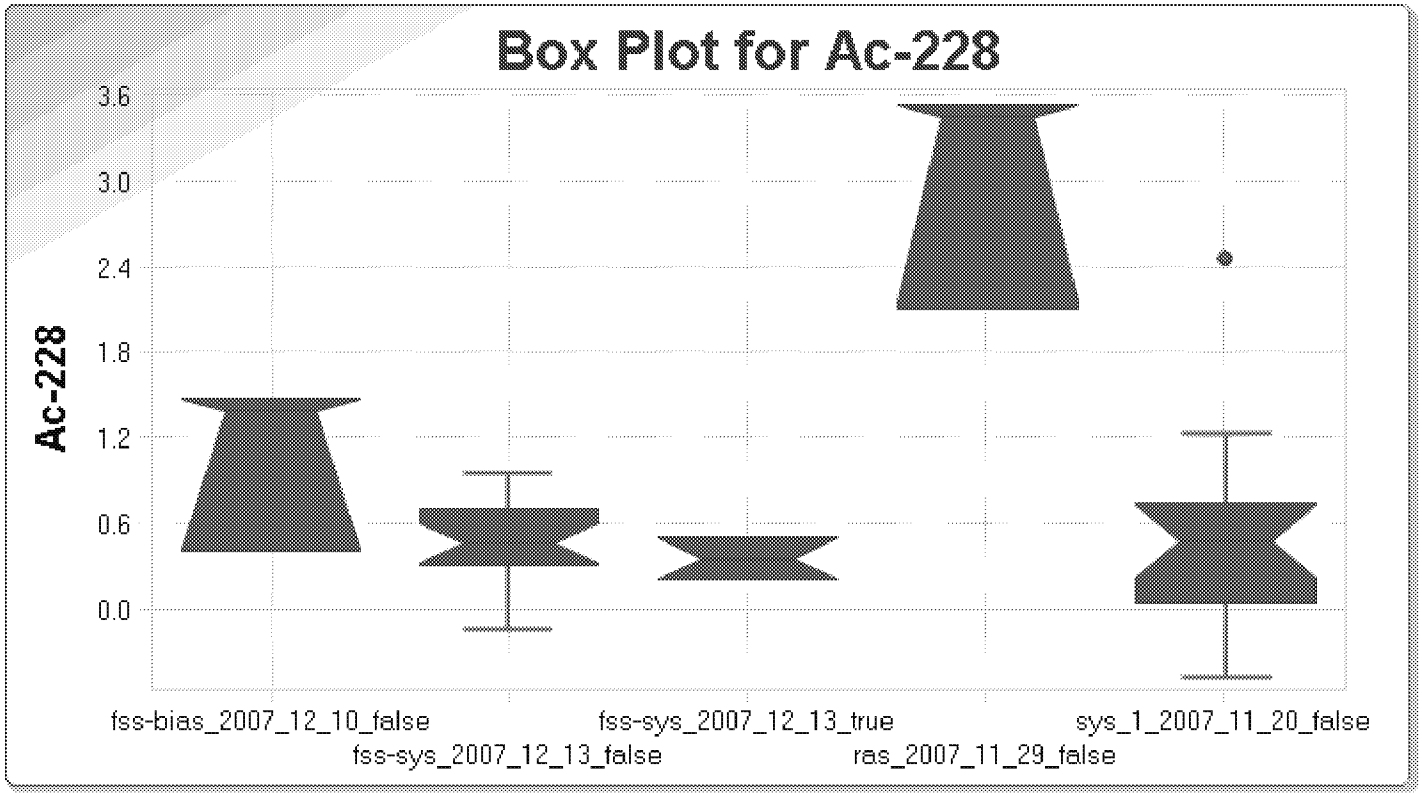

Box Plot for K-40
K-40
12
10
8
6
4
2
fss-bias_2007_12_10_false
fss-sys_2007_12_13_false
fss-sys_2007_12_13_true
ras_2007_11_29_false
sys_1_2007_11_20_false

Parcel G – S0075




Box Plot for Bi-214
Bi-214
1.8
1.5
1.2
0.9
0.6
0.3
fss-bias_2007_12_10_false
fss-sys_2007_12_13_false
fss-sys_2007_12_13_true
ras_2007_11_29_false
sys_1_2007_11_20_false

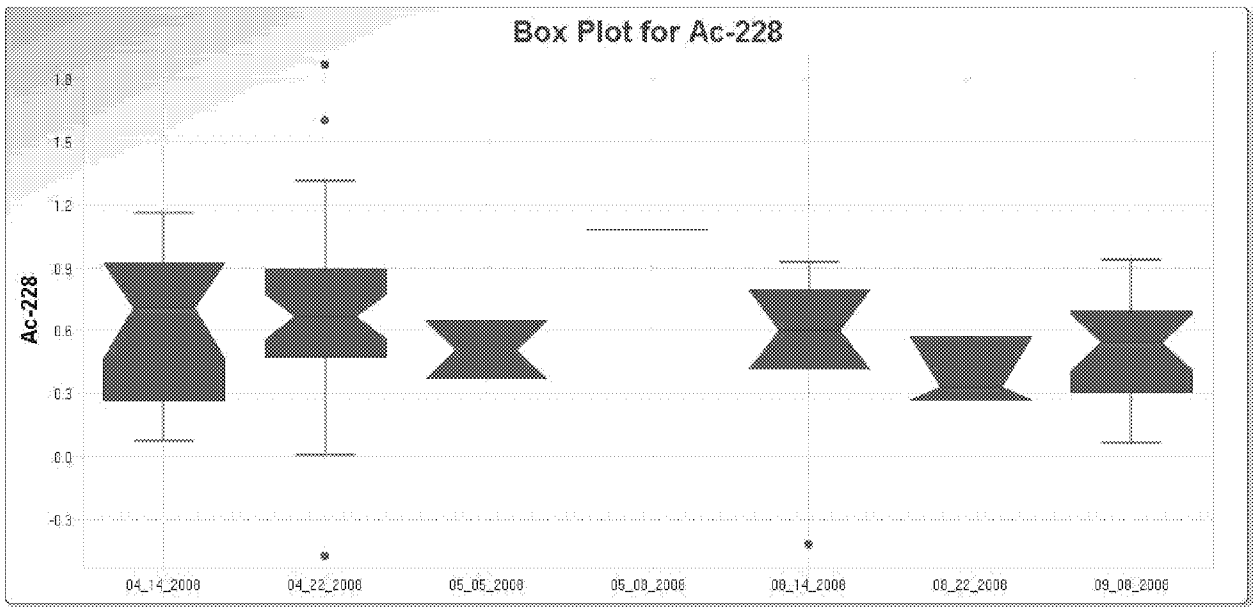
Parcel G – S0075

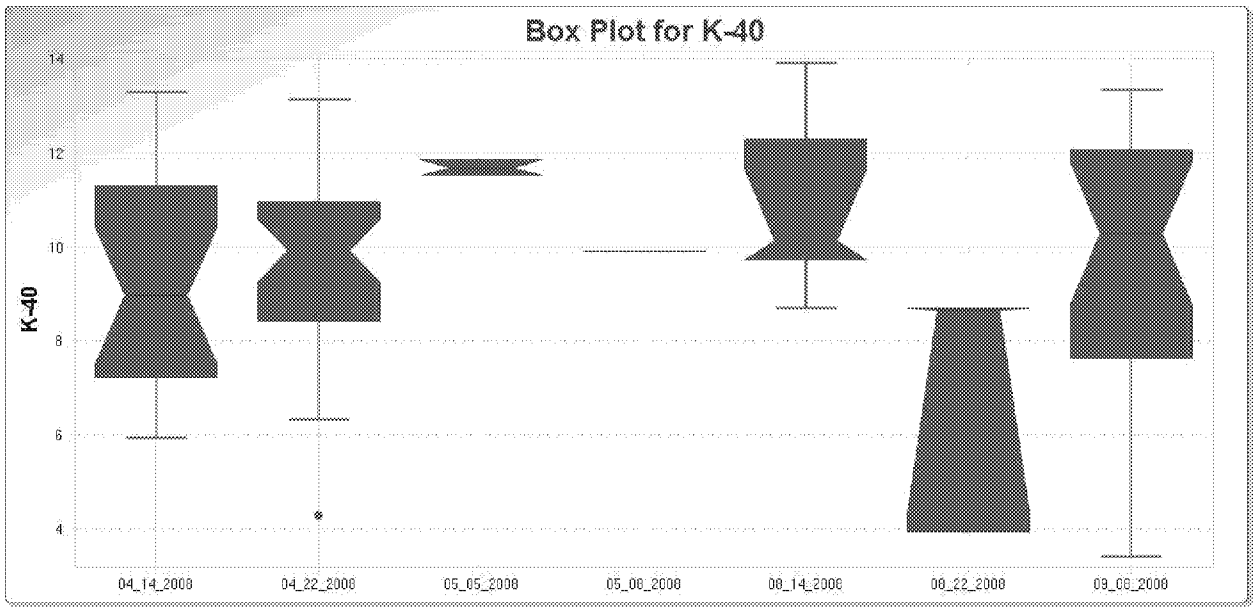


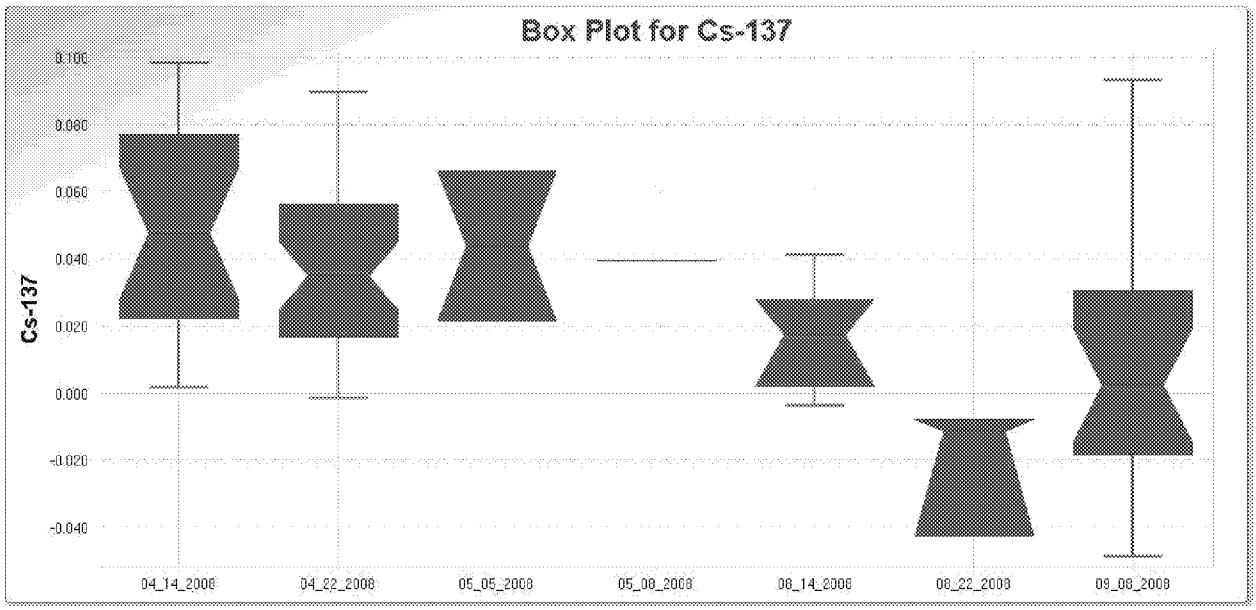
Parcel G – S0075

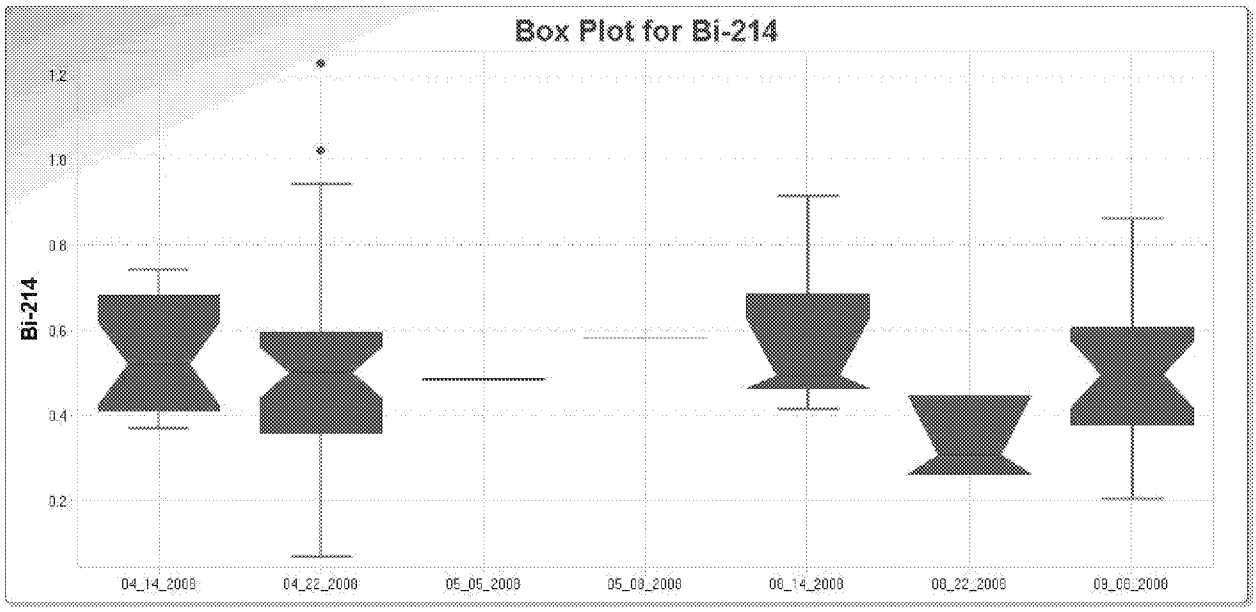
Parcel G – S0082

Variable	NumObs
Ac-228 (sys_1_04_14_2008)	19
Ac-228 (ras_04_22_2008)	37
Ac-228 (ras_05_05_2008)	2
Ac-228 (ras_05_08_2008)	1
Ac-228 (ras_08_14_2008)	7
Ac-228 (fss-bias_08_22_2008)	3
Ac-228 (fss-sys_09_08_2008)	21



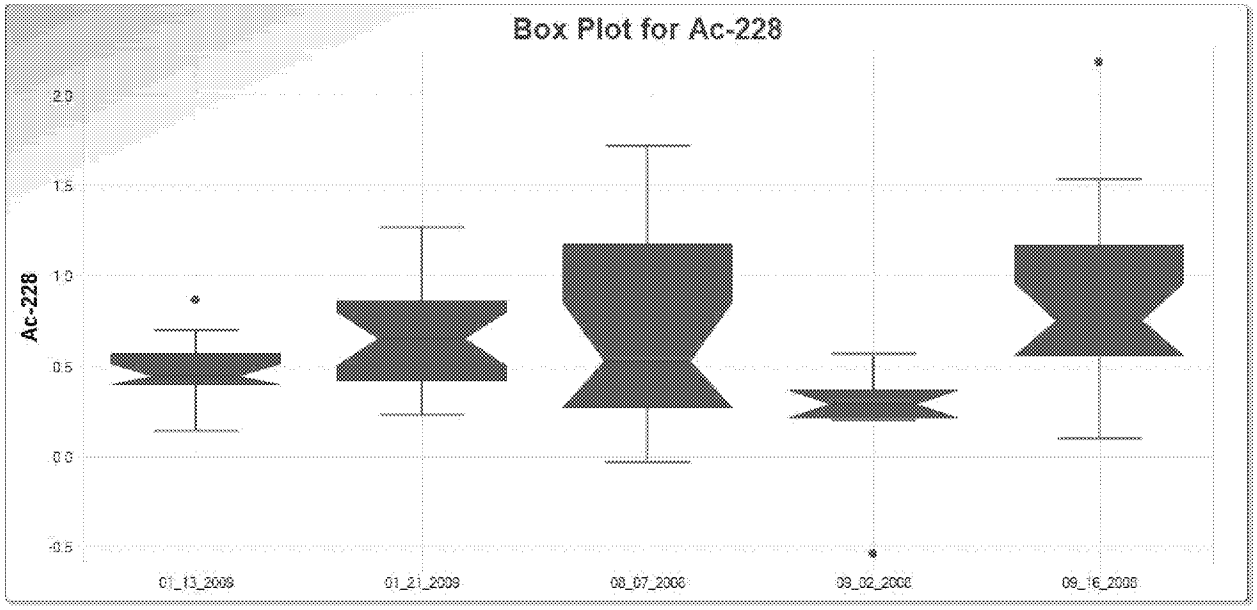

Box Plot for K-40
K-40
14
12
10
8
6
4
04_14_2008
04_22_2008
05_05_2008
05_08_2008
08_14_2008
08_22_2008
09_08_2008


Box Plot for Cs-137
Cs-137
0.100
0.080
0.060
0.040
0.020
0.000
-0.020
-0.040
04_14_2008
04_22_2008
05_05_2008
05_08_2008
08_14_2008
08_22_2008
09_08_2008

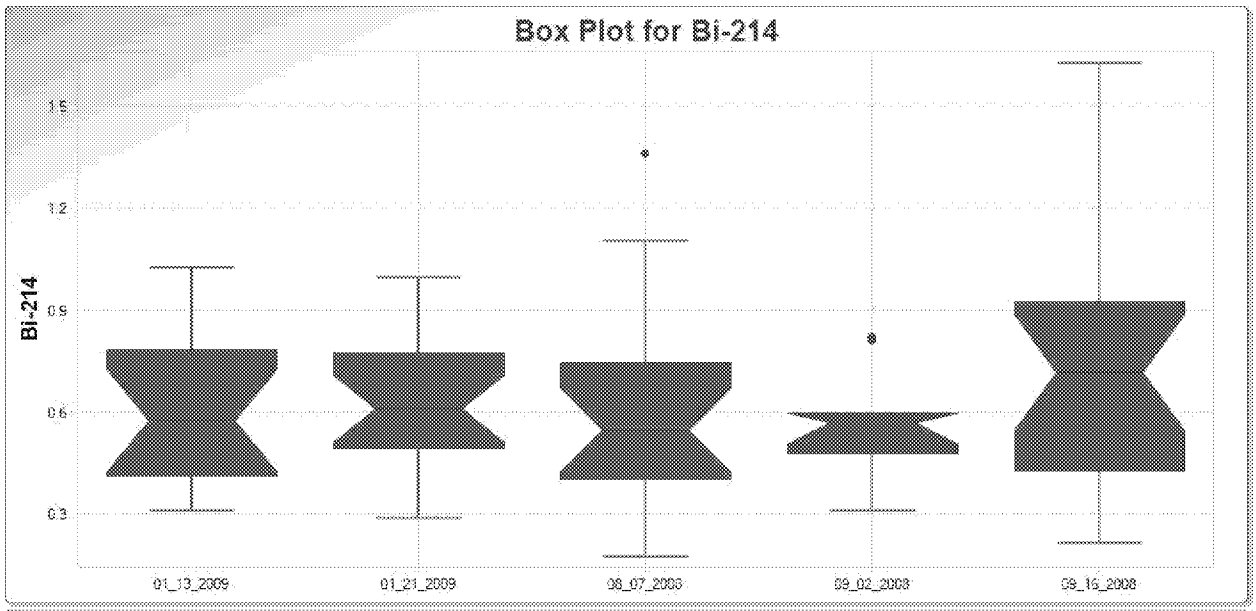

Box Plot for Bi-214
Bi-214
1.2
1.0
0.8
0.6
0.4
0.2
04_14_2009
04_22_2009
05_05_2009
05_09_2009
08_14_2009
08_22_2009
09_08_2009

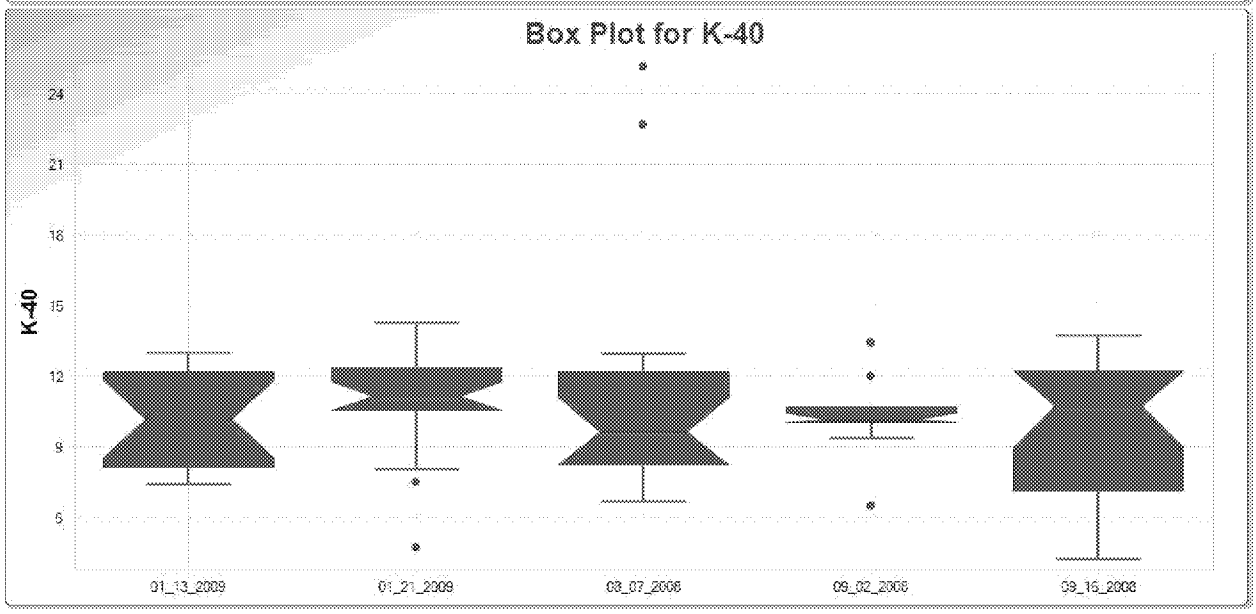
PARCEL G – S0091

Survey (Date)	Number of Samples
SYS-1 (08_07_2008)	19
FSS-BIAS (09_02_2008)	9
SYS-1 (09_16_2008)	21
FSS-BIAS (01_13_2009)	15
FSS-SYS (01_21_2009)	21

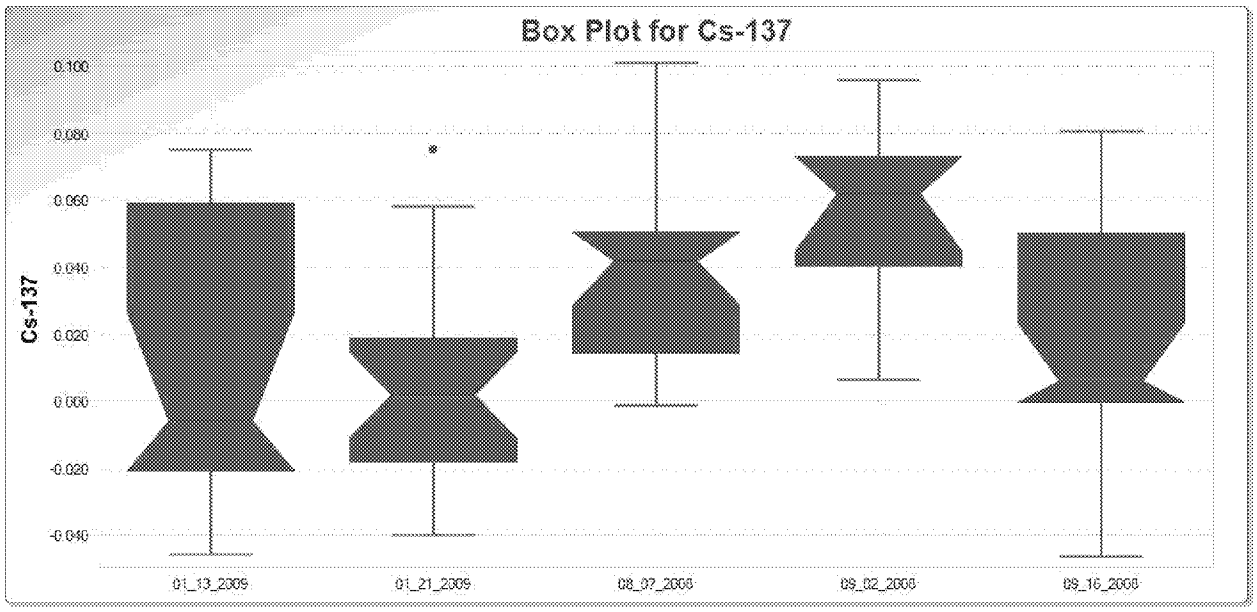


PARCEL G – S0091





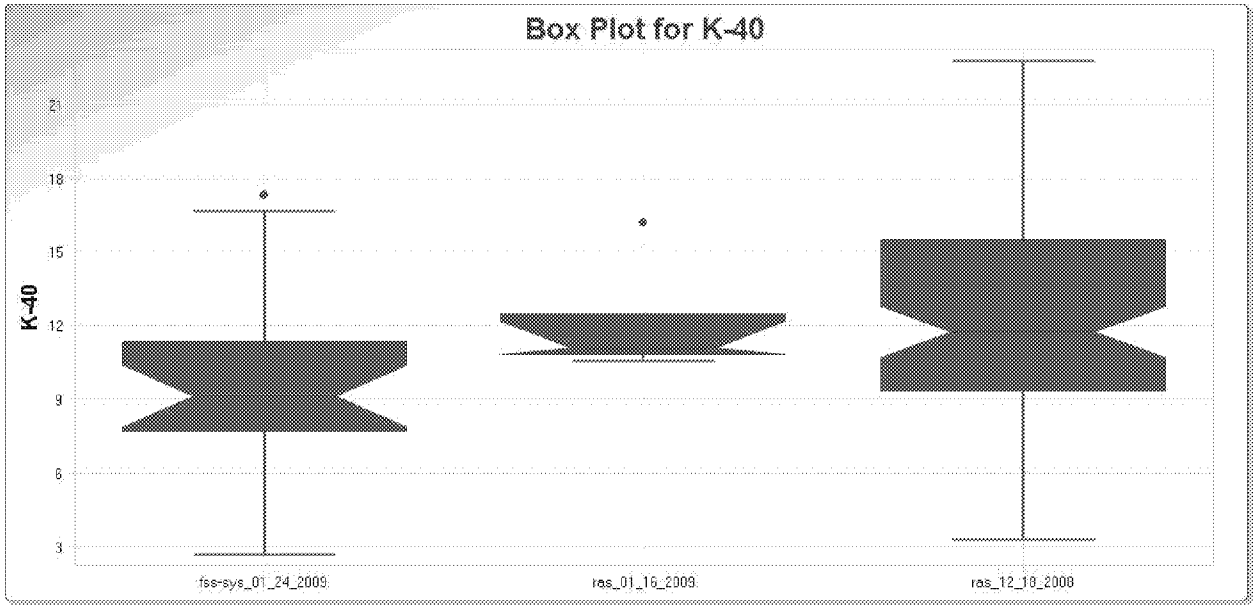
PARCEL G – S0091

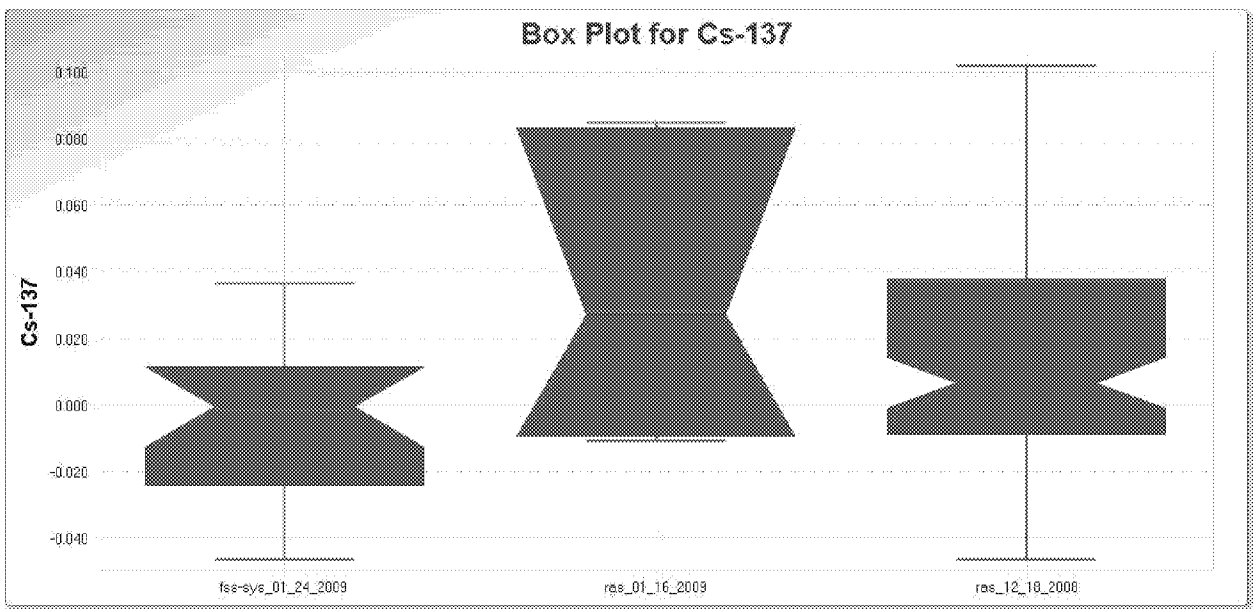


Parcel G S0121

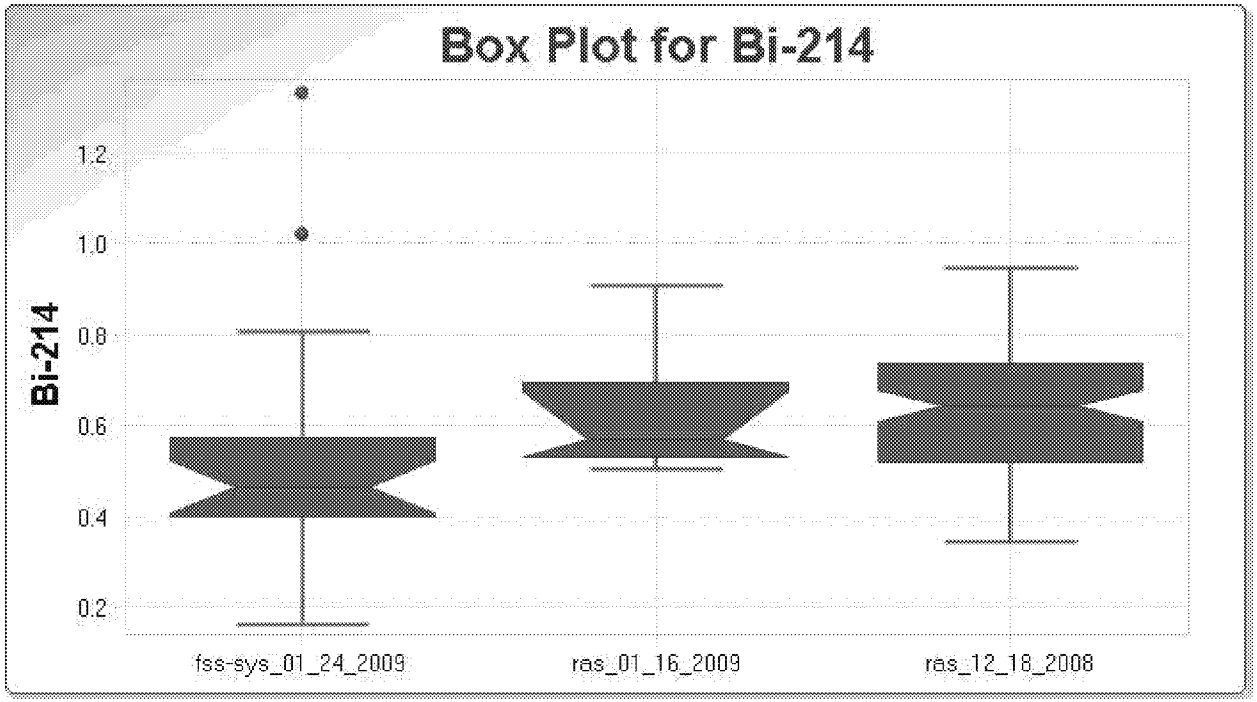
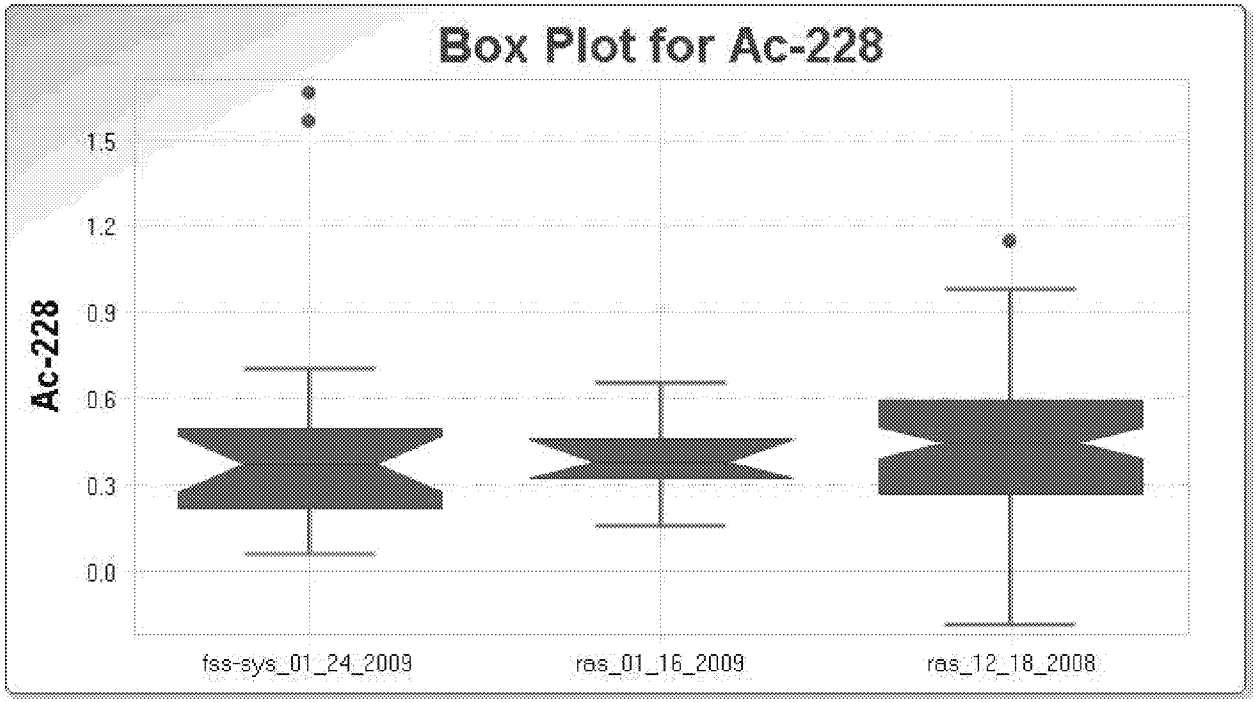
Variable	NumObs	# Missing	Minimum	Maximum	Mean	Geo-Mean	SD	CV
Ac-228 (fss-sys_01_24_2009)	21	0	0.0628	1.66	0.471	0.356	0.412	0.874
Ac-228 (ras_01_16_2009)	6	0	0.162	0.647	0.391	0.36	0.16	0.41
Ac-228 (ras_12_18_2008)	87	0	-0.178	1.146	0.443	N/A	0.227	0.513
Bi-214 (fss-sys_01_24_2009)	21	0	0.168	1.33	0.529	0.475	0.269	0.508
Bi-214 (ras_01_16_2009)	6	0	0.51	0.906	0.631	0.618	0.151	0.239
Bi-214 (ras_12_18_2008)	87	0	0.348	0.944	0.634	0.619	0.133	0.209
Cs-137 (fss-sys_01_24_2009)	21	0	-0.046	0.0364	-0.00653	N/A	0.0254	-3.886
Cs-137 (ras_01_16_2009)	6	0	-0.0105	0.0846	0.0338	N/A	0.0436	1.29
Cs-137 (ras_12_18_2008)	87	0	-0.046	0.101	0.0137	N/A	0.033	2.406
K-40 (fss-sys_01_24_2009)	21	0	2.755	17.33	9.74	9.06	3.596	0.369
K-40 (ras_01_16_2009)	6	0	10.62	16.18	12.06	11.92	2.126	0.176
K-40 (ras_12_18_2008)	87	0	3.347	22.71	12.49	11.72	4.328	0.346

Parcel G S0121





Parcel G S0121



Parcel G S0121