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Periodic Monitoring Report for Vapor-Sampling Activities at Material Disposal Area T, Consolidated Unit 21-016(a)-99, at Technical Area 21, June to August 2009

Los Alamos
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EXECUTIVE SUMMARY

This periodic monitoring report summarizes the latest results of the vapor-monitoring activities (June–August 2009) conducted at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, within Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory). The objectives of vapor-monitoring at MDA T are (1) to collect additional samples from vapor-monitoring wells previously sampled at MDA T and (2) to compare the results with previously detected volatile organic compound (VOC) concentrations and tritium activities in pore gas beneath MDA T.

Samples were collected in June, July, and August of 2009 from vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059 located outside the MDA T nuclear facility boundary. Vapor-monitoring wells 21-25262 and 21-603059 are located immediately south of MDA T. Vapor-monitoring wells 21-25264 and 21-603058 are located immediately north of MDA T.

To date, vapor-monitoring wells 21-25264, 21-603058, and 21-603059 have been sampled for nine rounds, from October 2007 to August 2009, and the deep vapor-monitoring well 21-25262 has been sampled for three rounds, from June to August 2009. Pore-gas data collected from all locations sampled during June to August 2009 (rounds 7–9) are presented and compared in this report. In addition, vapor data presented and evaluated in the last periodic monitoring report for MDA T (rounds 5 and 6) are also presented and evaluated, as appropriate, to help establish trends over time.

A total of 28 VOCs were detected in MDA T pore gas during the June–August 2009 sampling activities, and the results are consistent with previous sampling results.

Tritium activities in vapor-monitoring wells 21-25262, 21-25264, 21-603058 were consistently low at TD but showed multiple peaks at varying depths in the middle ports. Tritium activities in vapor-monitoring well 21-603059 consistently increased with depth to TD.

The VOC vapor data collected during rounds 7–9 were also compared to screening levels (SLs), based on equilibrium partitioning of vapor with groundwater cleanup levels, to evaluate the potential for the reported VOC concentrations to result in contamination of groundwater in excess of cleanup levels. The VOC screening evaluation identified two VOCs, methylene chloride and 1,1,2-trichloroethane, in MDA T pore gas at concentrations resulting in a screening value greater than 1.0. However, the SLs were not exceeded for any VOCs for samples collected from the deepest sampling port; therefore, the current VOC concentrations detected at MDA T appear not to threaten groundwater in excess of cleanup levels.

Monthly sampling of vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059 and quarterly reporting will continue until June 2010 in conjunction with the installation and sampling of additional vapor-monitoring wells at MDA T.

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1.0 INTRODUCTION

This report presents the results of vapor-monitoring activities conducted during June–August 2009 at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 (TA-21) at Los Alamos National Laboratory (LANL or the Laboratory). These activities are being conducted per the requirements outlined in the MDA T vapor-monitoring plan and the associated New Mexico Environment Department (NMED) approval with modifications (LANL 2007, 098944; NMED 2007, 098946) and the approved MDA T Phase III investigation work plan and associated NMED correspondence (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455).

The objectives of the MDA T vapor-monitoring activities are (1) to collect additional vapor samples from vapor-monitoring wells previously sampled at MDA T and (2) to compare the results with previously detected volatile organic compound (VOC) concentrations and tritium activities beneath MDA T. In addition, this report presents the results of a screening evaluation of the pore-gas VOC data, which compares maximum concentrations of VOCs in pore gas to pore-gas screening levels (SLs). This conservative screening process evaluates the potential for the observed VOC concentrations to result in contamination of groundwater above cleanup levels.

To date, intermediate vapor-monitoring wells 21-25264, 21-603058, and 21-603059 have been sampled for nine rounds, from October 2007 to August 2009, and the deep vapor-monitoring well 21-25262 has been sampled for three rounds, from June to August 2009. All pore-gas samples were submitted for off-site analysis of VOCs and tritium.

This report primarily presents and discusses all results obtained during the latest monitoring activities (June–August 2009, rounds 7, 8, and 9); however, vapor data presented and evaluated in the last periodic monitoring report for MDA T (rounds 5 and 6) are also included in the data evaluation section of this report, as appropriate, for comparison as well as for establishing trends over time. The MDA T vapor data collected during rounds 1–6 are presented and discussed in previous periodic monitoring reports as well as the Phase III investigation report (LANL 2009, 105187; LANL 2009, 106665; LANL 2009, 107106). Information on radioactive materials and radionuclides, including the results of sampling and analysis of radioactive constituents, is voluntarily provided to NMED in accordance with U.S. Department of Energy policy.

1.1 Site Location and Description

MDA T is located within TA-21 on DP Mesa and contains the following waste storage and disposal sites: (1) four absorption beds (subsurface), (2) multiple buried shafts (subsurface), and (3) a former retrievable waste storage area (subsurface) (Figures 1.0-1 and 1.0-2). Current vegetation at MDA T includes grasses, chamisa bushes, and two young ponderosa pines. The top of the regional aquifer occurs approximately 1300 ft below MDA T, based on water-level information from regional well R-6 (Kleinfelder 2005, 091693). The MDA T investigation report (LANL 2006, 094151) presents further details regarding MDA T waste storage and disposal sites, operations, and historical investigation activities.

2.0 SCOPE OF ACTIVITIES

As directed by the approved MDA T vapor-monitoring plan (LANL 2007, 098944; NMED 2007, 098946) and the approved MDA T Phase III investigation work plan (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455), nine rounds of pore-gas field-screening and sampling activities have been completed at intermediate-depth vapor-monitoring wells 21-603058, 21-603059, and 21-25264, and three rounds have been completed at deep vapor-monitoring well 21-25262 (Figure 1.0-2 and Table 2.0-1).

Per the approved MDA T vapor-monitoring plan (LANL 2007, 098944; NMED 2007, 098946), five vapor-sampling ports were installed at wells 21-603058 and 21-25264 at the following intervals: (1) base elevation of the nearby disposal unit (sampling port 1, 69–81 ft); (2) depths correlated to the 2005–2006 sampling port depths at locations 21-25262 and 21-25263 (sampling ports 2–4); and (3) borehole total depth (TD) (sampling port 5) and six vapor-sampling ports were installed at well 21-603059. Per the approved MDA T Phase III investigation work plan (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455), nine vapor-sampling ports were installed at well 21-25262 at the following intervals: (1) depths correlated to the sampling port depths at well 21-603059 (sampling ports 1– 4); (2) depths correlated to different lithologic units encountered beneath MDA T (i.e., Cerro Toledo interval of the Bandelier Tuff [sampling port 5], Otowi Member of the Bandelier Tuff [sampling ports 6–8], and the Guaje Pumice Bed [sampling port 9]); and (3) borehole TD (sampling port 9).

During the most recent sampling, a total of 90 pore-gas samples (69 characterization and 21 quality assurance/quality control [QA/QC]) were collected for VOC analysis, and 81 samples (69 characterization and 12 QA/QC) were collected for tritium analysis from (1) five out of five ports in well 21-25264; (2) five out of six ports in well 21-603059; (3) four out of five ports in well 21-603058; and (4) nine out of nine ports in well 21-25262. Field duplicate (FD) samples were collected at a minimum frequency of 1 for every 10 samples. Samples were not collected at port 2 in either well 21-603058 or 21-603059 for reasons discussed in section 2.1. Table 2.0-1 summarizes the June–August 2009 pore-gas sampling depths and sample collection dates by well location. Table 2.0-2 summarizes the June–August 2009 samples collected at MDA T monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059 and their respective analyses.

All samples were collected in accordance with the current version of standard operating procedure (SOP) EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air, and submitted to off-site analytical laboratories for VOC analysis using U.S. Environmental Protection Agency (EPA) Method TO-15 and for tritium analysis using EPA Method 906.0. Further discussion of the field methods used for pore-gas field-screening and sample collection are presented in Appendix B. Field chain-of-custody (COC) forms and sample collection logs (SCLs) are provided on a CD (Appendix D). No investigation-derived waste was generated during execution of vapor-monitoring activities at MDA T.

Atmospheric information was obtained from http://www.srh.noaa.gov/data/obhistory/KLAM.html on each day of sampling using the closest automated weather station to MDA T (Los Alamos Airport, latitude 35.88 degrees, longitude 106.28 degrees). Table 2.0-3 summarizes the barometric pressure, temperature, and relative humidity for the sampling dates.

The June–August 2009 pore-gas field-screening results are presented in section 4, and the June–August 2009 pore-gas analytical results are evaluated in section 5. Any deviations from the scope of activities presented in the approved MDA T vapor-monitoring plan (LANL 2007, 098944; NMED 2007, 098946) and/or the approved MDA T Phase III investigation work plan (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455) are presented in the following section.

2.1 Deviations

Pore-gas samples were not collected from port 2 in either vapor-monitoring well 21-603058 or 21-603059 during the June–August 2009 sampling activities at MDA T. As previously reported, sampling port 2 (160.5–165.5 ft below ground surface [bgs]) in vapor-monitoring well 21-603058 stopped producing pore gas after February 2008 (round 2) either because of a mechanical failure or because it was installed within unit 2 of the Bandelier Tuff, a densely welded unit, which may inhibit vapor flow (LANL 2009, 105187). Sampling port 2 (112.5–117.5 ft bgs) in vapor-monitoring well 21-603059 has never produced pore gas since it was installed, again possibly because of its positioning within a massive welded unit (unit 2) (LANL 2009, 105187).

3.0 REGULATORY CRITERIA

The March 1, 2005, Compliance Order on Consent (the Consent Order) does not identify any cleanup standards, risk-based screening levels (SLs), risk-based cleanup goals, or other regulatory criteria for pore gas at MDA T. Therefore, an analysis was conducted to evaluate the potential for contamination of groundwater by VOCs in pore gas using SLs based on groundwater cleanup levels in the Consent Order. The analysis evaluated the groundwater concentration that would be in equilibrium with the maximum concentrations of VOCs detected at MDA T during the three of the most recent monitoring events (June–August 2009). The equilibrium relationship between air and water concentrations is described by the following equation.

$$C_{water} = C_{air} / H' \qquad \textbf{Equation 3.0-1}$$

Where C_{water} = the volumetric concentration of contaminant in water,

C_{air} = the volumetric concentration of contaminant in air, and

H' = dimensionless form of Henry's law constant.

If the predicted concentration of a particular VOC in groundwater is less than the SL, then no potential exists for an exceedance of the groundwater cleanup level at the contaminant/groundwater interface. The June–August 2009 MDA T VOC pore-gas data are discussed in section 5.2.

Because no SLs for pore gas address the potential for groundwater contamination, the screening evaluation was based on groundwater standards or tap water SLs and Henry's law constants that describe the equilibrium relationship between vapor and water concentrations. The source of the Henry's law constants is the NMED technical background document (NMED 2009, 106420) or the EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm). The following dimensionless form of Henry's law constant was used:

$$H' = \frac{C_{air}}{C_{water}} \qquad \textbf{Equation 3.0-2}$$

Equation 3.0-2 can be used to calculate the screening value (SV):

$$SV = \frac{C_{air}}{1000 \times H' \times SL} \qquad \textbf{Equation 3.0-3}$$

where C_{air} is the concentration of a particular VOC in the pore-gas sample (µg/m^3), H' is the dimensionless Henry's law constant, SL is the screening level (µg/L), and 1000 is a conversion factor from L to m^3. The groundwater standards are the EPA maximum contaminant level (MCL) or New Mexico Water Quality Control Commission (NMWQCC) groundwater standard, whichever is lower. If there is no MCL or NMWQCC standard, the EPA regional tap water SL (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm) is used and adjusted to 10^{-5} risk for carcinogens. The numerator in Equation 3.0-3 is the actual concentration of the VOC in pore gas, and the denominator represents the pore-gas concentration needed to exceed the SL. Therefore, if the SV is less than 1, the concentration of the VOC in pore gas does not exceed the SL, even if the VOC plume were to come in contact with groundwater. Table 3.0-1 presents the calculated concentrations of contaminants in pore gas corresponding to groundwater SLs.

4.0 FIELD-SCREENING RESULTS

Before each sampling event, field screening was performed in each well and targeted sampling port to ensure percent carbon dioxide (%CO_2) and oxygen (%O_2) levels had stabilized at levels representative of subsurface pore-gas conditions. Table 4.0-1 summarizes all field-screening results obtained during the June–August 2009 sampling events at MDA T monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059 by sampling port and sampling round.

5.0 ANALYTICAL DATA RESULTS

Analytical results for VOCs in pore gas were produced from laboratory analyses of vapor collected in SUMMA canisters and analyzed using EPA Method TO-15. Analytical results for tritium were produced from laboratory analysis of vapor collected in silica gel columns and analyzed using EPA Method 906.0. All analytical data were subject to extensive QA/QC and data validation reviews in accordance with Laboratory guidance and procedures. The QA/QC and data validation review for June–August 2009 MDA T pore-gas data are presented in Appendix C. All validated analytical results from June–August 2009 pore-gas sampling are presented on a CD in Appendix D.

A systematic low bias in previously reported tritium pore-vapor measurements has been identified (Whicker et al. 2009, 106429); tritium data presented in this report have been corrected for this bias (Marczak 2009, 106500). The bias resulted from the properties of silica gel, the medium used to collect water vapor from pore-gas samples. Silica gel contains water bound to the silica gel molecules that cannot be completely removed by drying before it is used in sampling without degrading the silica gel properties. Thus, when water vapor is collected from the pore gas, the tritiated water vapor is diluted into the water bound to the silica gel molecules. Tritium values for the June and July sampling rounds were corrected using the percent moisture value determined by the analytical laboratory. Tritium values for the August sampling round were corrected using silica gel field weights.

5.1 VOC Pore-Gas Results

VOC results from rounds 7–9 are summarized in Table 5.1-1. Concentration with depth profiles for each VOC detected in each well for all samples collected during rounds 7–9 are presented, by sampling round, in Figures 5.1-1 through 5.1-12.

A total of 28 VOCs were detected in MDA T pore gas during the June–August 2009 sampling activities, and the results are consistent with previous sampling results. Five VOCs, methylene chloride, carbon tetrachloride, chloroform, trichloroethene (TCE), and tetrachloroethene (PCE), were consistently detected at the greatest concentrations relative to other detected VOCs during rounds 7–9. Concentration with depth profiles for each of these five COPCs for all samples collected during rounds 7–9 are presented by well in Figures 5.1-13 through 5.1-17. Results obtained for these COPCs during sampling rounds 5 and 6 (February and April 2009) are also presented in Figures 5.1-13 through 5.1-17 for comparison and for evaluating trends over time in MDA T vapor.

As illustrated in Figures 5.1-1 through 5.1-17 and discussed below, the results of the MDA T pore-gas VOC sampling during rounds 7–9 show several general trends. These results are consistent with results obtained during earlier sampling rounds (LANL 2009, 105187; LANL 2009, 106665; LANL 2009, 107106).

- Methylene chloride pore-gas concentrations consistently increased with depth to TD in intermediate-depth vapor-monitoring wells 21-25264, 21-603058, and 21-603059. In deep vapor-monitoring well 21-25262, methylene chloride concentrations increased with depth to a maximum at ~575 ft bgs before decreasing with depth to TD (Figure 5.1-13). Only two exceptions to this trend have been noted: in October 2007 and in April 2009 for wells 21-603058 and 21-603059, respectively, when methylene chloride concentrations decreased from the second deepest port to TD.
- Carbon tetrachloride pore-gas concentrations also increased with depth in all four vapor-monitoring wells to ~250–300 ft bgs; after 300 ft bgs, carbon tetrachloride decreased with depth to TD (Figure 5.1-14).
- Chloroform pore-gas concentrations displayed an “S”-shaped profile in vapor-monitoring wells 21-25262 and 21-603059, in which the concentrations were higher near the surface, lower at the lower-middle ports, and lowest in the upper-middle ports and at TD (Figure 5.1-15). Chloroform results obtained from sampling intermediate-depth vapor-monitoring wells 21-25264 and 21-603058 were less consistent between rounds but, on average, the concentrations increased slightly with depth to TD in both wells during rounds 7–9.
- Like chloroform, TCE pore-gas concentrations also displayed an “S”-shaped profile in vapor-monitoring wells 21-25262 and 21-603059 but not in intermediate-depth vapor-monitoring wells 21-25264 and 21-603058 (Figure 5.1-16). In intermediate-depth vapor-monitoring wells 21-25264 and 21-603058, the concentration trends were again less consistent between wells and sampling rounds: during rounds 7–9, TCE concentrations, on average, slightly increased with depth to TD in vapor-monitoring well 21-603058 but decreased with depth to TD in vapor-monitoring well 21-25264.
- PCE concentrations consistently decreased with depth to TD in all four vapor-monitoring wells (Figure 5.1-17).
- Acetone; benzene; bromodichloromethane; 1,3-butadiene; 1-butanol; 2-butanone; carbon disulfide; cyclohexane; 1,2-dichlorobenzene; 1,4-dichlorobenzene; dichlorodifluoromethane; 1,2-dichloroethane; cis-1,2-dichloroethene; hexane; 2-propanol; propylene; tetrahydrofuran; toluene; 1,1,2-trichloro-1,2,2-trifluoroethane; 1,1,1-trichloroethane; and 1,3-xylene+1,4-xylene concentrations showed no trends. These VOCs were either infrequently detected or detected at very low concentrations (at or near the standard quantitation limits [SQLs]).
- Dichloroethene[1,1-] and 1,1,2-trichloroethane are both detected at depths of ~250–300 ft bgs in vapor-monitoring wells 21-25262 and 21-603059. Concentrations increased with depth to sampling port 6 (475 ft bgs) in vapor-monitoring well 21-25262, and then decreased in sampling port 9 (TD at 688 ft bgs). These two VOCs are detected at lower concentrations in vapor-monitoring well 21-603058, which is consistent with the trends previously observed during rounds 1–6.
- Ten VOCs previously detected during rounds 1–6 (bromoform; chlorodibromomethane; ethanol; ethylbenzene; 4-ethyltoluene; 2-hexanone; 4-methyl-2-pentanone; n-heptane; 1,3,5-trimethylbenzene; and 1,2-xylene) were not detected during rounds 7–9. In previous rounds, these VOCs were infrequently detected and at very low concentrations (at or near the SQL).

- Butadiene[1,3-] and 1,2-dichlorobenzene were detected for the first time in round 8 (July 2009). Butadiene[1,3-] was detected at a concentration of 7.4 μg/m^3 in a single sample collected at port 9 (~690 ft bgs) in vapor-monitoring well 21-25262; however, this result is low, near the SQL. The analyte 1,2-dichlorobenzene was detected at a concentration of 83 μg/m^3 in a single sample collected at port 4 (~245 ft bgs) in vapor-monitoring well 21-603058 and was not detected in any deeper sample.

5.2 VOC Screening Evaluation

The VOC results from the June–August 2009 sampling rounds were screened to evaluate whether the concentrations of VOCs could be a potential source of groundwater contamination. Because no SLs for pore gas address the potential for groundwater contamination, the screening evaluation was based on groundwater standards or tap water SLs and Henry's law constants that describe the equilibrium relationship between vapor and water concentrations (section 3.0).

Equation 3.0-3 was used to calculate SVs for the maximum concentrations of VOCs detected at MDA T during the June–August 2009 sampling. The evaluation included the 25 detected VOCs in MDA T samples for which there are MCLs, NMWQCC standards, or EPA regional tap water SLs (Table 5.2-1). Propylene, 2-propanol, and tetrahydrofuran were detected but do not have MCLs, NMWQCC standards, or tap water SLs and were not evaluated.

The results of the June–August 2009 VOC screening evaluation are presented in Table 5.2-1. The SVs were less than 1.0 for all detected VOCs, except for methylene chloride and 1,1,2-trichloroethane; the maximum concentration of PCE resulted in an SV equal to 1.0. The concentrations of methylene chloride in 20 out of 69 samples collected resulted in SVs greater than 1.0, with a maximum SV of 3.2. The maximum concentration of 1,1,2-trichloroethane resulted in an SV of 1.2.

Previous screening evaluations identified only methylene chloride with an SV greater than 1.0 (LANL 2009, 105187; LANL 2009, 106665). PCE and 1,1,2-trichloroethane concentrations with SVs greater than or equal to 1.0 are the result of recently revised Henry's law constants (NMED 2009, 106420).

All three of these VOCs decrease from the maximum concentration with depth to TD in well 21-25262 and have maximum SVs less than 1.0 at TD (Table 5.2-2), indicating that VOC concentrations currently observed in MDA T subsurface vapor appear not to threaten groundwater in excess of cleanup levels.

5.3 Pore-Vapor Tritium Results

The results of the June–August 2009 sampling for tritium are summarized in Table 5.3-1. Certain activity trends observed during the June–August 2009 sampling period in intermediate wells 21-25264, 21-603058, and 21-603059 are similar to those reported during previous sampling rounds 5 and 6 (Figure 5.3-1):

- During both June and July sampling events, pore-gas tritium activities were substantially higher in samples collected from well 21-25264 than in samples collected from wells 21-603058 and 21-603059, with the maximum tritium activity (173,113 pCi/L) in a sample collected during round 8 (July 2009) at port 2 (at 155.5 ft bgs).
- Wells 21-25264 and 21-603058 illustrate one or two peaks of tritium activity at a particular sampling port, followed by a marked decrease to TD. For all three sampling rounds, tritium activities in well 21-603058 showed an increase to approximately 250 ft bgs, followed by a decrease to TD.

- During the June–August 2009 sampling period, well 21-603059 tritium activities consistently increased with depth, with a maximum tritium activities in samples collected at TD.
- Tritium activities in intermediate well 21-25264 during the August sampling period were unusually low (ranging from 2–198 pCi/L in August versus 2093–173,113 pCi/L in June and July). However, the lower range of tritium activities observed during round 9 is more consistent with the tritium activities observed in the other vapor-monitoring wells during both previous and current sampling rounds.

Well 21-25262 was also sampled for the first time during the June–August 2009 sampling period, with the following results.

- Well 21-25262 shows one or two peaks of tritium activity at a particular port, followed by a marked decrease to TD:
    - ❖ Peak 1: ~230 ft bgs (June 2009); ~330 ft bgs (July 2009); ~330 ft bgs (August 2009)
    - ❖ Peak 2: ~375 ft bgs (June 2009); ~575 ft bgs (August 2009); no second peak for July 2009
- The highest tritium activities in well 21-25262 are greater than the tritium activities observed at intermediate wells 21-603058 and 21-603059 but are much less than the tritium activities observed at well 21-25264 (with the exception of August 2009). The maximum tritium activities in well 21-25262 were from samples collected at ~375 ft bgs (13,958.3 pCi/L [June 2009]; 37,413.2 pCi/L [July 2009]; 40,119.3 pCi/L [August 2009]) and decreased to TD (686 ft bgs).

6.0 SUMMARY

The objectives of the MDA T vapor-monitoring activities are (1) to collect additional vapor samples from boreholes previously sampled at MDA T and (2) to compare the results with previously detected VOC concentrations and tritium activities beneath MDA T. Wells 21-25262, 21-25264, 21-603058, and 21-603059 were sampled from June–August 2009 per the requirements outlined in the approved MDA T vapor-monitoring plan (LANL 2007, 098944; NMED 2007, 098946) and the approved MDA T Phase III investigation work plan (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455). The results of the most recent monitoring activities (rounds 7–9) indicate similar trends to those reported during previous monitoring activities (rounds 1–6) (LANL 2009, 105187; LANL 2009, 106665; LANL 2009, 107106).

A review of the analytical results from the June–August 2009 monitoring activities detected a total of 28 VOCs and tritium in the pore gas beneath MDA T (Tables 5.1-1 and 5.3-1). Concentrations for 23 of the 28 VOCs detected in MDA T pore gas decreased with depth, were consistently detected at or near the SQL, or were infrequently detected. These results are consistent with data obtained during previous monitoring periods (LANL 2009, 105187; LANL 2009, 106665; LANL 2009, 107106).

Five VOCs, methylene chloride, carbon tetrachloride, chloroform, TCE, and PCE, were consistently detected throughout the MDA T monitoring period at the greatest concentrations relative to the other detected VOCs. Methylene chloride pore-gas concentrations consistently increased with depth to total TD in intermediate-depth vapor-monitoring wells 21-25264, 21-603058, and 21-603059. In deep vapor-monitoring well 21-25262, methylene chloride concentrations increased with depth to a maximum at ~575 ft bgs before decreasing with depth to TD. Carbon tetrachloride pore-gas concentrations also increased with depth in all four vapor-monitoring wells to ~250–300 ft bgs; after 300 ft bgs, carbon tetrachloride decreased with depth to TD. Chloroform and TCE pore-gas concentrations show an

"S"-shaped profile in vapor-monitoring wells 21-25262 and 21-603059, in which the concentrations were highest near the surface, lower at the lower-middle ports, and lowest in the upper-middle ports and at TD. Chloroform and TCE pore-gas concentrations in intermediate-depth vapor-monitoring wells 21-25264 and 21-603058 were less consistent between rounds, but overall (1) chloroform concentrations increased slightly with depth to TD in both wells and (2) TCE concentrations increased slightly with depth to TD in vapor-monitoring well 21-603058 and decreased with depth to TD in vapor-monitoring well 21-25264. PCE concentrations consistently decreased with depth to TD in all four vapor-monitoring wells.

Analytical results for tritium have been corrected to account for the impact of silica gel–bound water. All activities presented in this report (including those provided in Appendix D) have been corrected. All data discussions reflect the corrected tritium concentrations.

Consistent with previous results, tritium activities were substantially higher in samples collected from well 21-25264 than in samples collected from wells 21-25262, 21-603058, and 21-603059 (except during the August 2009 sampling period). Tritium activities in all wells, except at intermediate well 21-603059, have one or two peaks at a particular port, followed by a marked decrease to TD. Intermediate well 21-603059 consistently showed an increase in tritium activities to TD throughout the June–August 2009 monitoring period.

The VOC vapor data collected during rounds 7–9 were also compared to SLs, based on equilibrium partitioning of vapor with groundwater cleanup levels, to evaluate the potential for the reported VOC concentrations to result in contamination of groundwater in excess of cleanup levels. The VOC screening evaluation identified two VOCs, methylene chloride and 1,1,2-trichloroethane, in MDA T pore gas at concentrations resulting in an SV greater than 1.0. However, the maximum concentrations of methylene chloride and 1,1,2-trichloroethane reported in the deepest MDA T pore-gas sample (691 ft bgs in vapor-monitoring well 21-25262) resulted in SVs well below 1.0. Therefore, the VOC concentrations observed at MDA T do not appear to threaten groundwater in excess of cleanup levels.

Vapor-monitoring activities are scheduled to continue at MDA T per the requirements outlined in the approved MDA T Phase III investigation work plan (LANL 2009, 105645; NMED 2009, 106455; NMED 2009, 105691). Wells 21-25262, 21-25264, 21-603058, and 21-603059 will be monitored on a monthly basis, in conjunction with the sampling (on completion and installation) of new monitoring wells at MDA T, until June 2010. Data collected during future monitoring activities at wells 21-25262, 21-25264, 21-603058, and 21-603059 will be presented and evaluated, as available, in subsequent quarterly monitoring and investigation reports (LANL 2009, 105645; NMED 2009, 105691; NMED 2009, 106455).

7.0 REFERENCES AND MAP DATA SOURCES

7.1 References

The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Kleinfelder, April 2005. “Final Completion Report, Characterization Wells R-6/R-6i,” report prepared for Los Alamos National Laboratory, Project No. 37151, Albuquerque, New Mexico. (Kleinfelder 2005, 091693)

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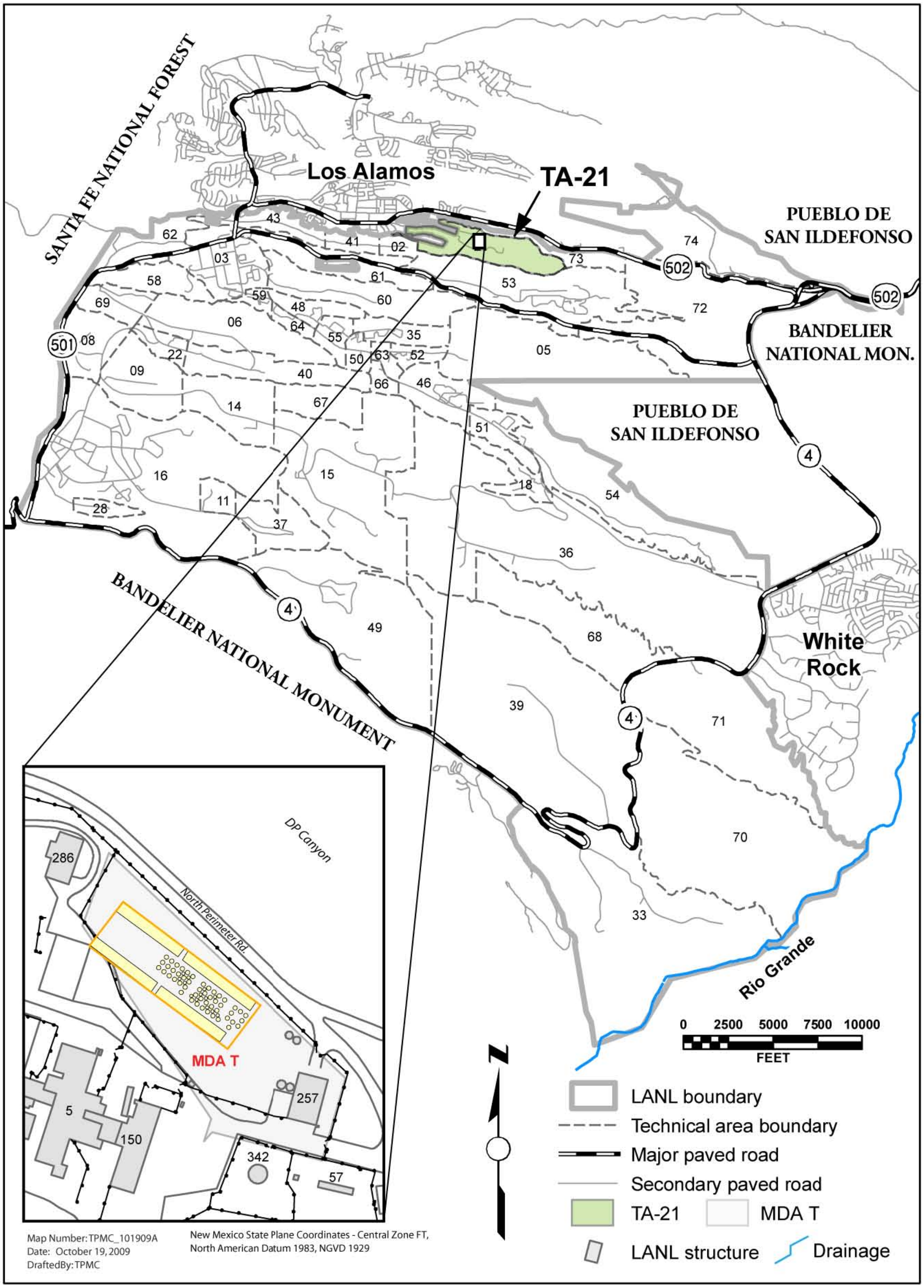
Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. "Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel," Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

7.2 Map Data Sources

Data sources used in original figures created for this report are described below and identified by legend title.

Legend Item/Type	Data Source
Rio Grande	Drainage Arcs; Los Alamos National Laboratory; Water Quality and Hydrology Group; 03 June 2003
LANL boundary	LANL Areas Used and Occupied; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
TA boundary	Technical Area Boundaries; Los Alamos National Laboratory, Site Planning & Project Initiation Group, Infrastructure Planning Division; 19 September 2007.
NES boundary	Nuclear Environmental Sites; Los Alamos National Laboratory, EP Environment and Remediation Support Services Division, EP2006-1092; 1:2,500 Scale Data; 11 January 2007.
Major paved road	New Mexico roads; Earth Data Analysis Center, Albuquerque, NM; 01 December1995.
Paved road	Paved Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 January 2008.
Dirt road	Dirt Road Arcs; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 January 2008.
Structure	Structures; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 04 January 2008.
Former structure	Former Structures; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0441; 1:2,500 Scale Data; 08 August 2008.
Waste storage features	Waste Storage Features; Los Alamos National Laboratory, Environment and Remediation Support Services Division, GIS/Geotechnical Services Group, EP2007-0032; 1:2,500 Scale Data; 13 April 2007.
Contours	Hypsography, 100, 20, and 10 Foot Contour Intervals; Los Alamos National Laboratory, ENV Environmental Remediation and Surveillance Program; 1991.
Fence	Security and Industrial Fences and Gates; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Revised MDA T fence	Revised MDA T Fencing; Los Alamos National Laboratory, Waste and Environmental Services Division, unpublished data, personal communication with N. Plannerer.
Gas line	Primary Gas Distribution Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Water line	Water Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.

Legend Item/Type	Data Source
Electric line	Primary Electric Grid; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Sewer line	Sewer Line System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Steam line	Steam Line Distribution System; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Communication line	Communication Lines; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 08 August 2002; as published 28 May 2009.
Building-associated features /structures	Primary Landscape Features; Los Alamos National Laboratory, KSL Site Support Services, Planning, Locating and Mapping Section; 06 January 2004; as published 28 May 2009.
Sampling locations	Point Feature Locations of the Environmental Restoration Project Database; Los Alamos National Laboratory, Waste and Environmental Services Division, EP2008-0109; 4 June 2009.



Disclaimer: This map was created for work processes associated with the MDA T IR. All other uses for this map should be confirmed with the LANL Enviromental Programs Directorate.

Figure 1.0-1 Location of MDA T at TA-21

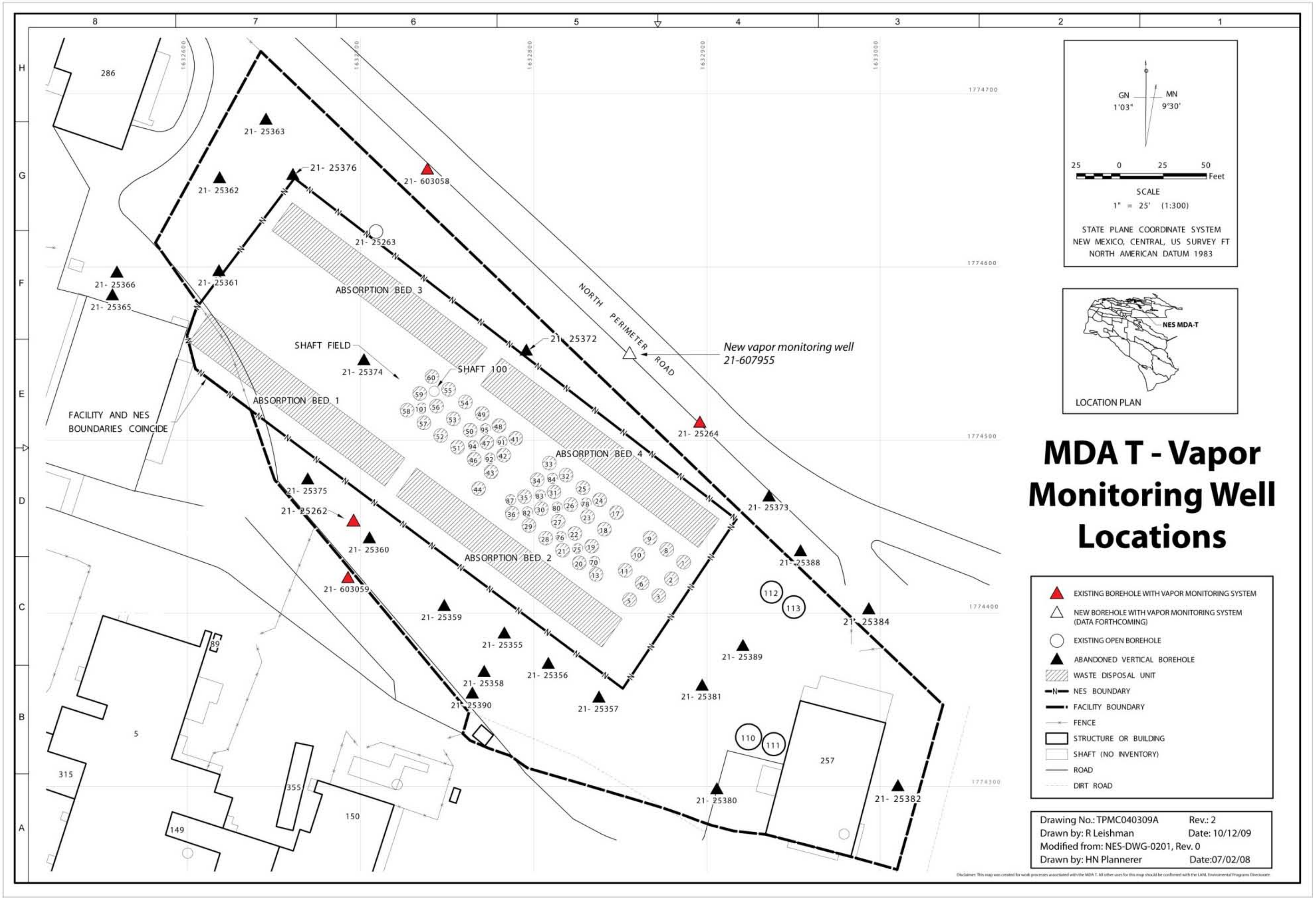


Figure 1.0-2 Locations of MDA T vapor-monitoring wells and associated structures and features

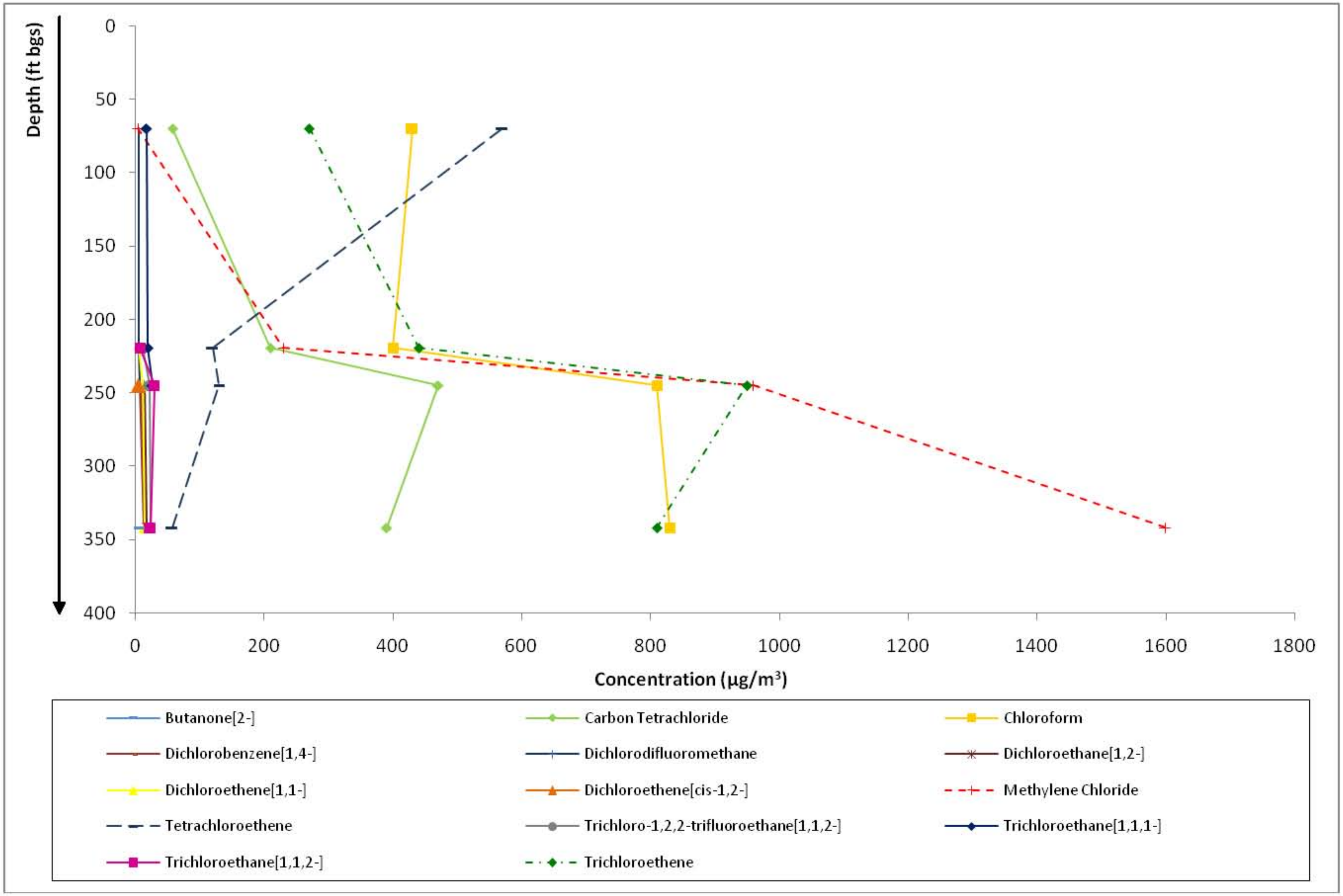


Figure 5.1-1 Vertical profile of detected VOCs in vapor-monitoring well 21-603058, round 7, June 2009

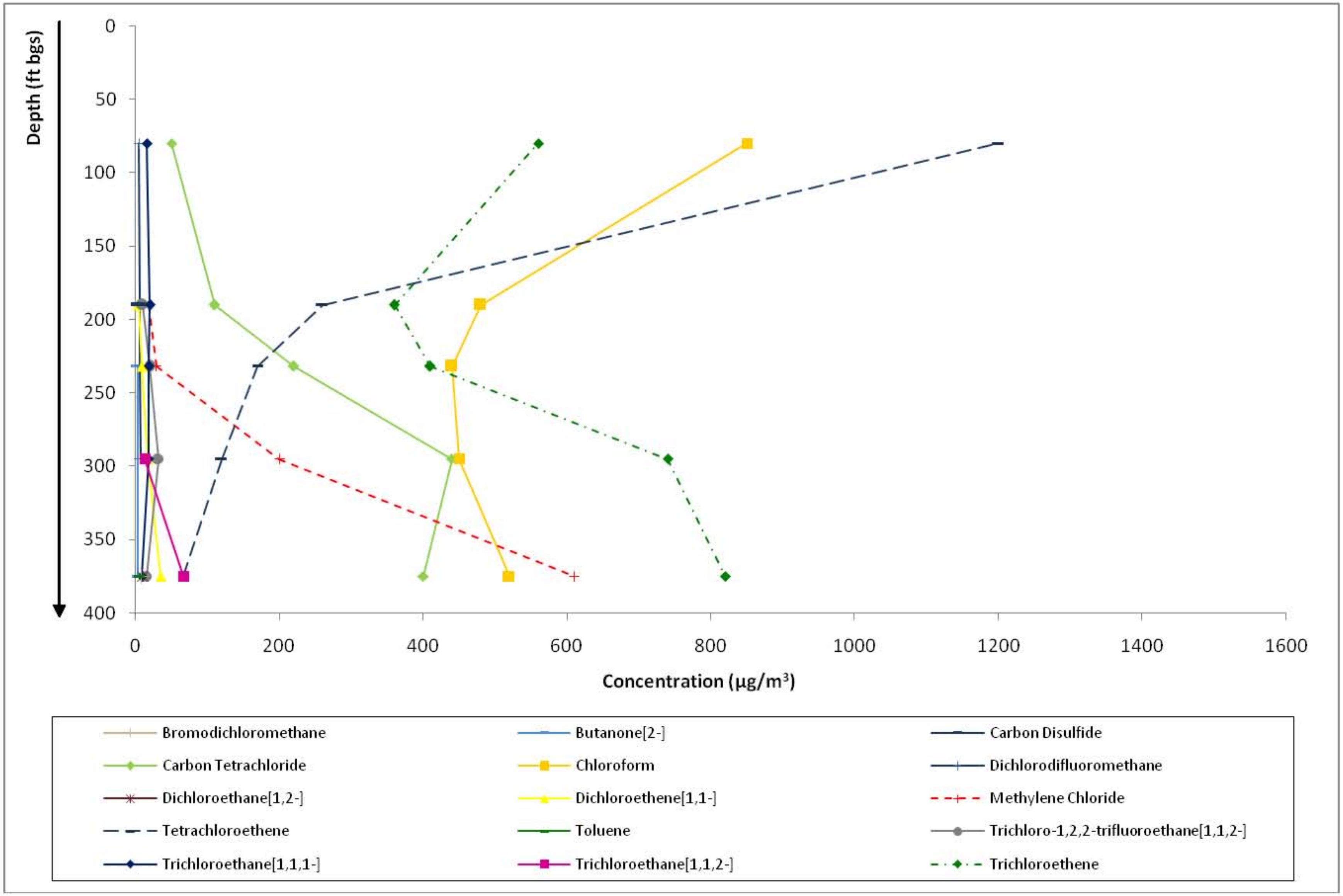


Figure 5.1-2 Vertical profile of detected VOCs in vapor-monitoring well 21-603059, round 7, June 2009

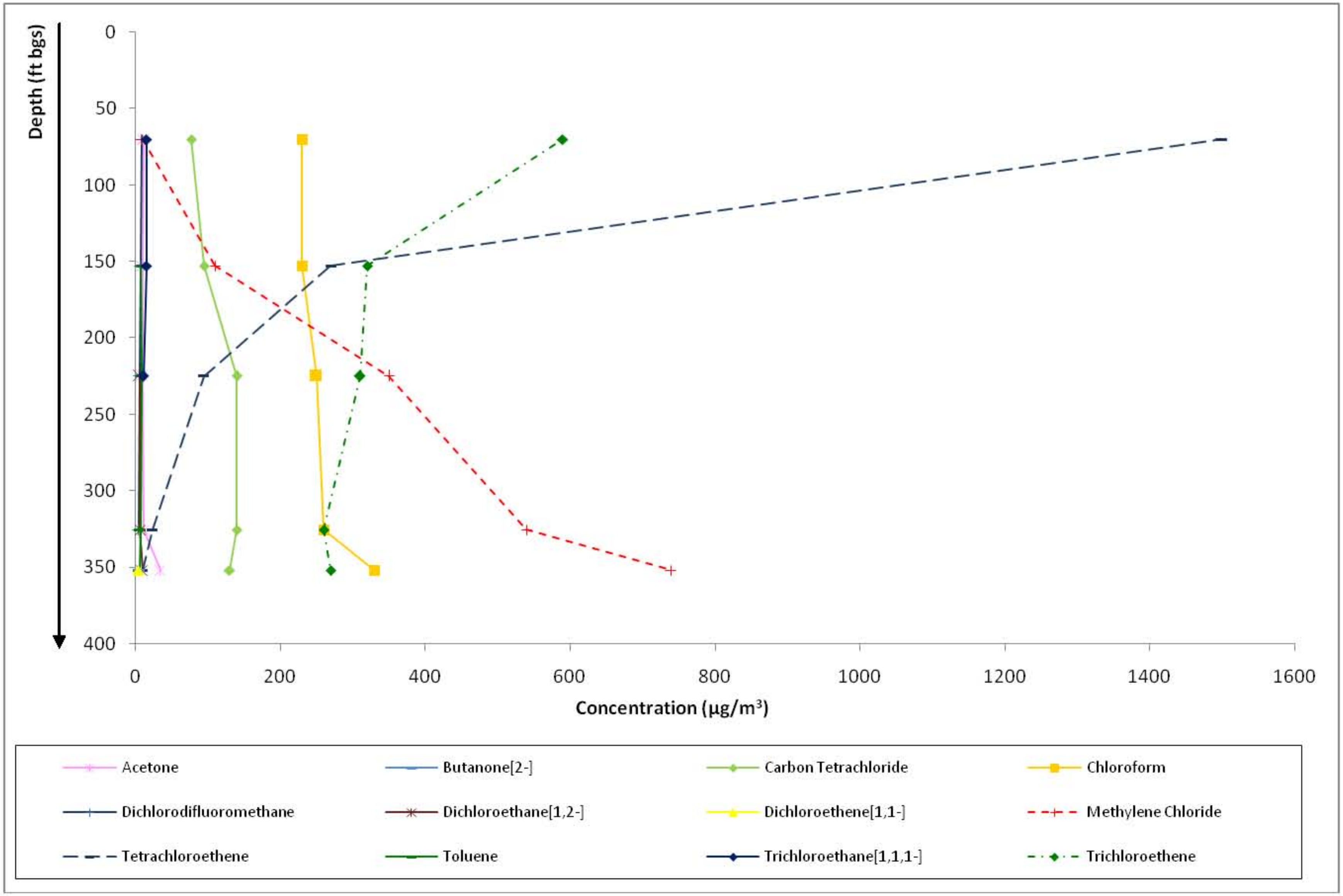


Figure 5.1-3 Vertical profile of detected VOCs in vapor-monitoring well 21-25264, round 7, June 2009

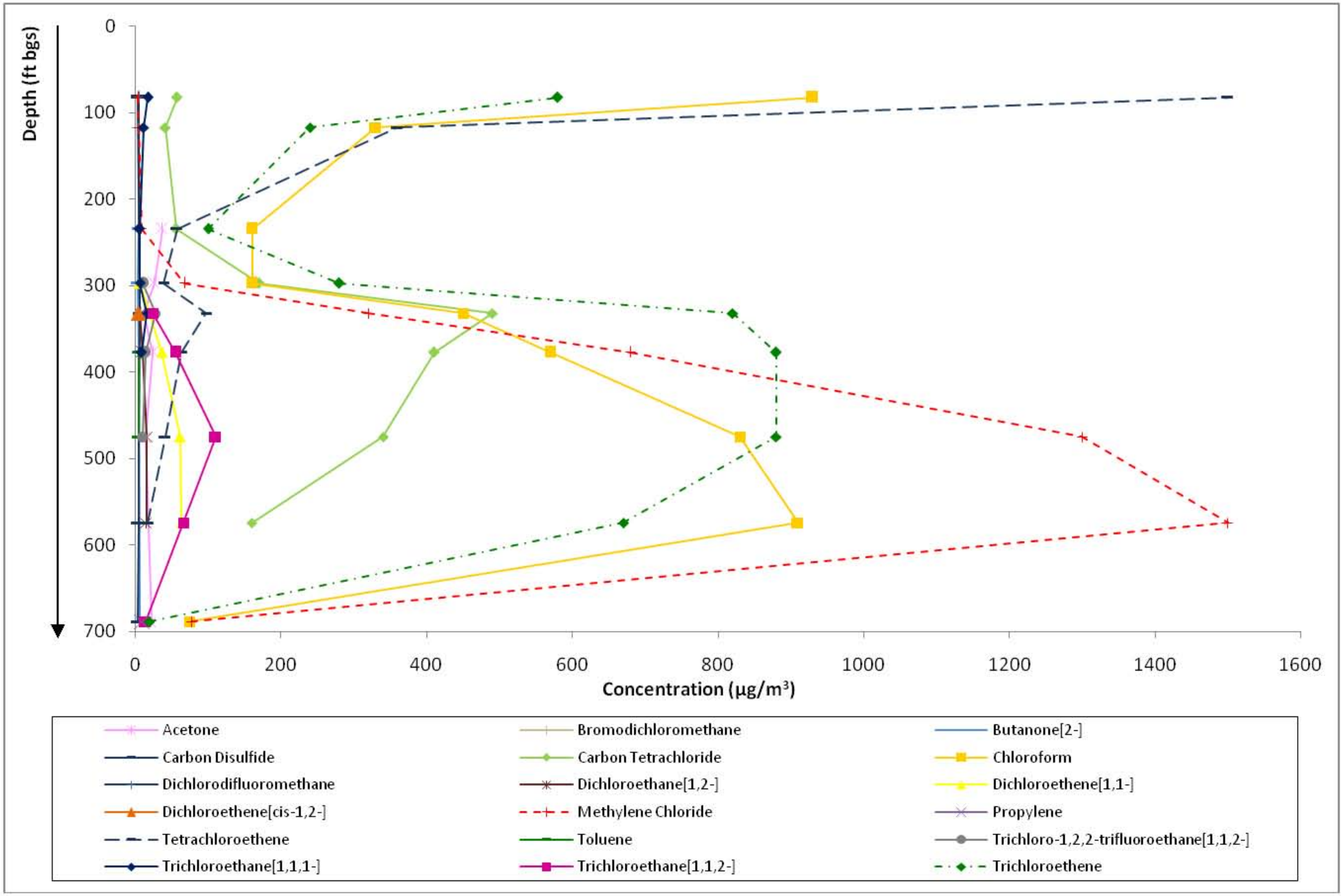


Figure 5.1-4 Vertical profile of detected VOCs in vapor-monitoring well 21-25262, round 7, June 2009

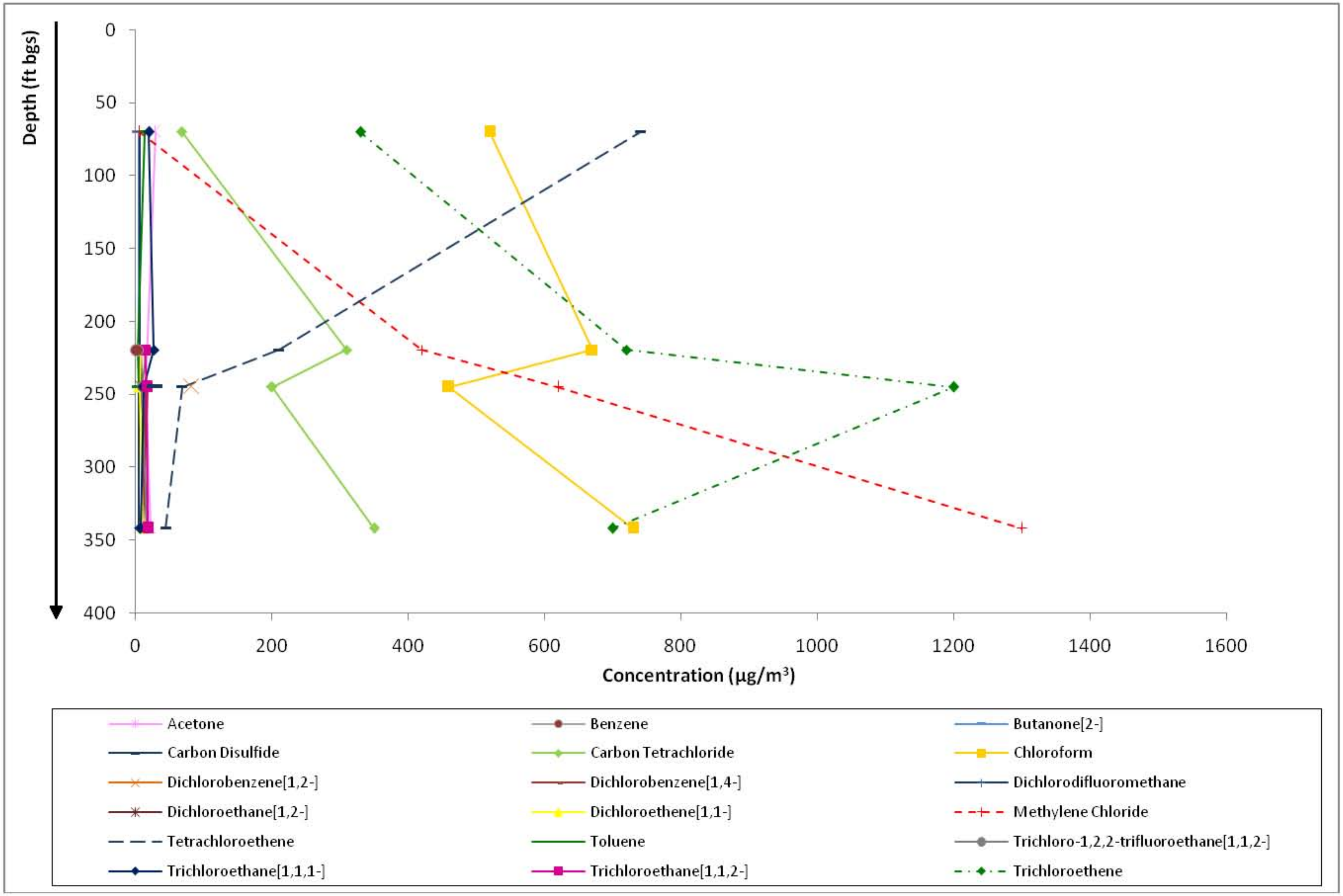


Figure 5.1-5 Vertical profile of detected VOCs in vapor-monitoring well 21-603058, round 8, July 2009

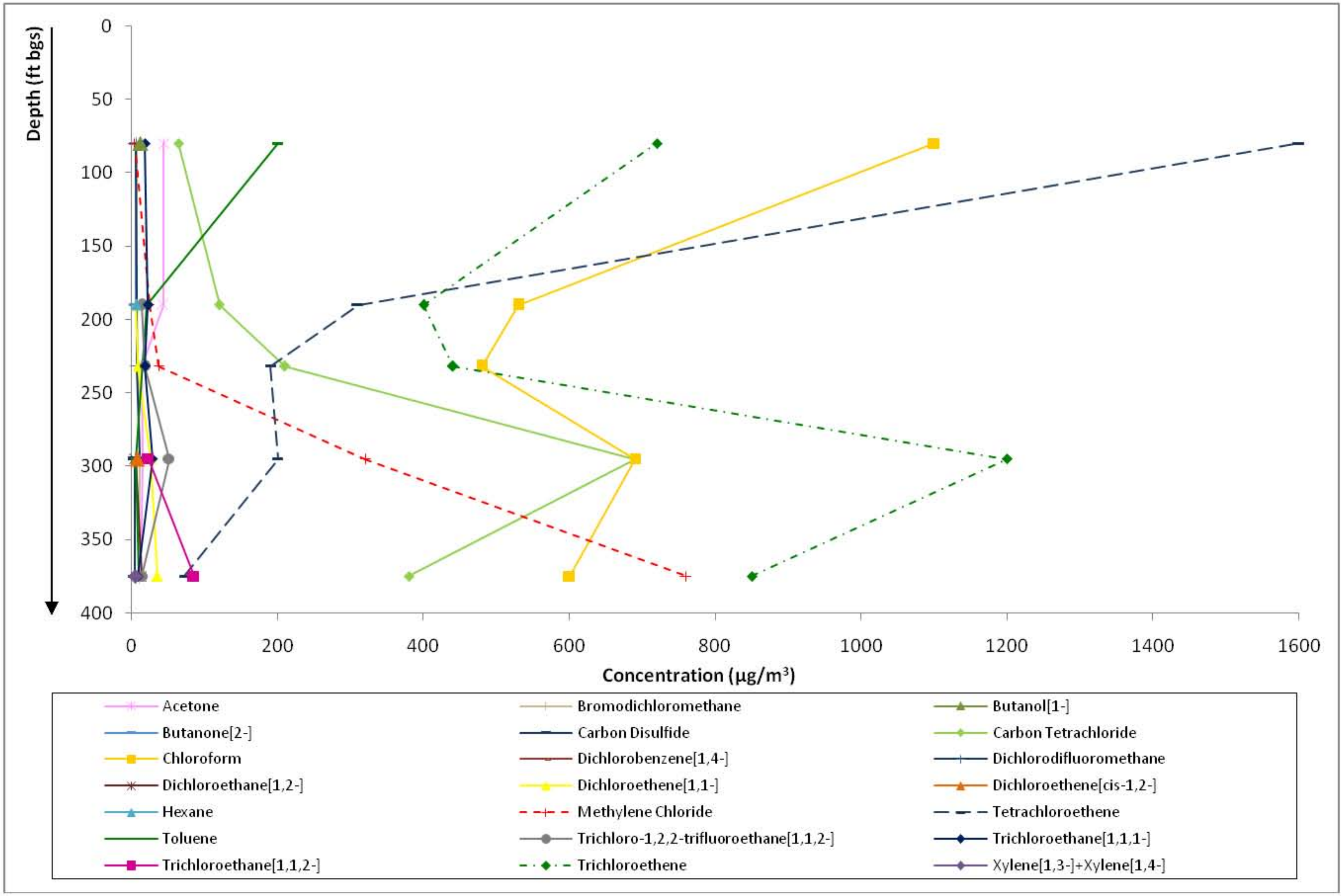


Figure 5.1-6 Vertical profile of detected VOCs in vapor-monitoring well 21-603059, round 8, July 2009

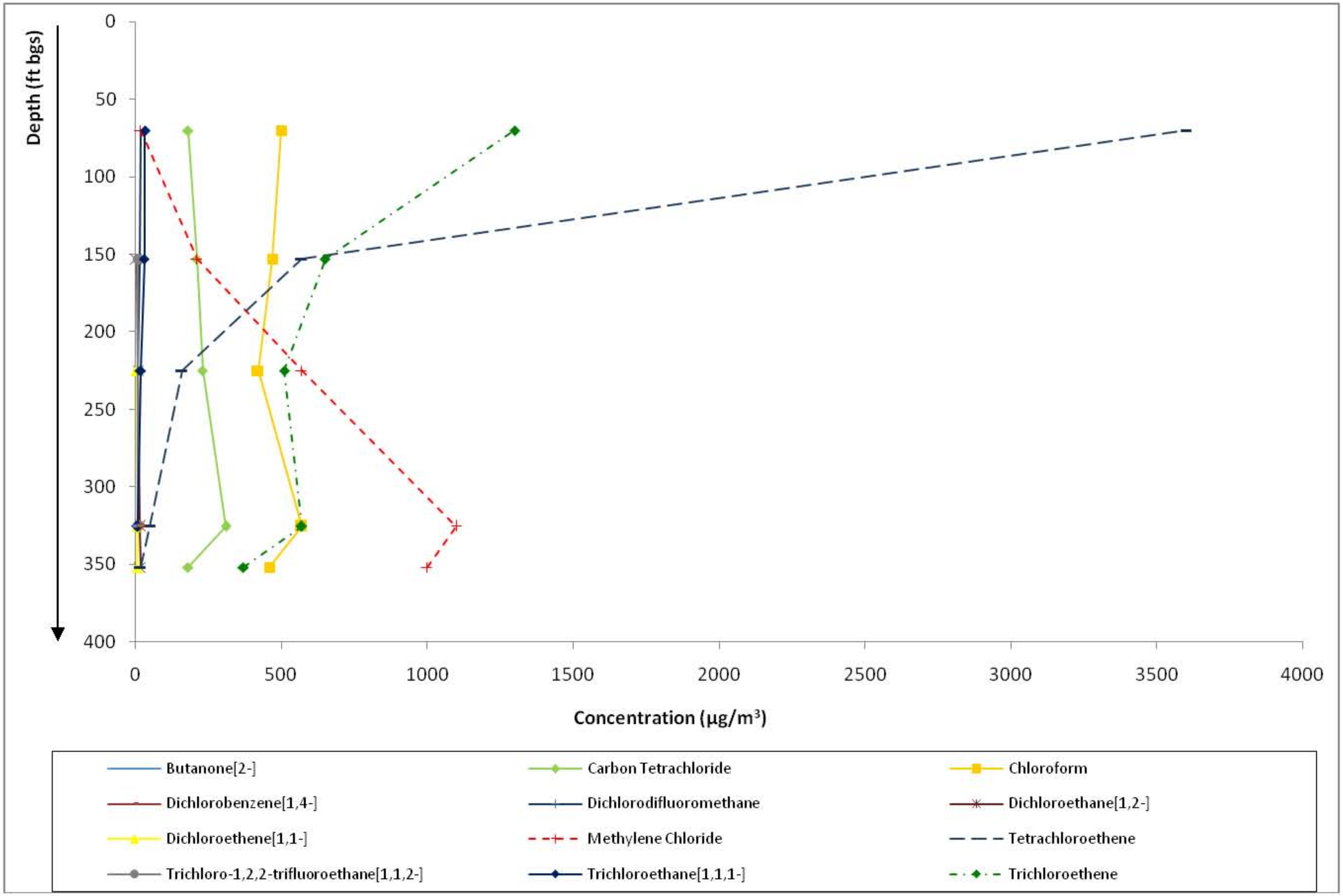


Figure 5.1-7 Vertical profile of detected VOCs in vapor-monitoring well 21-25264, round 8, July 2009

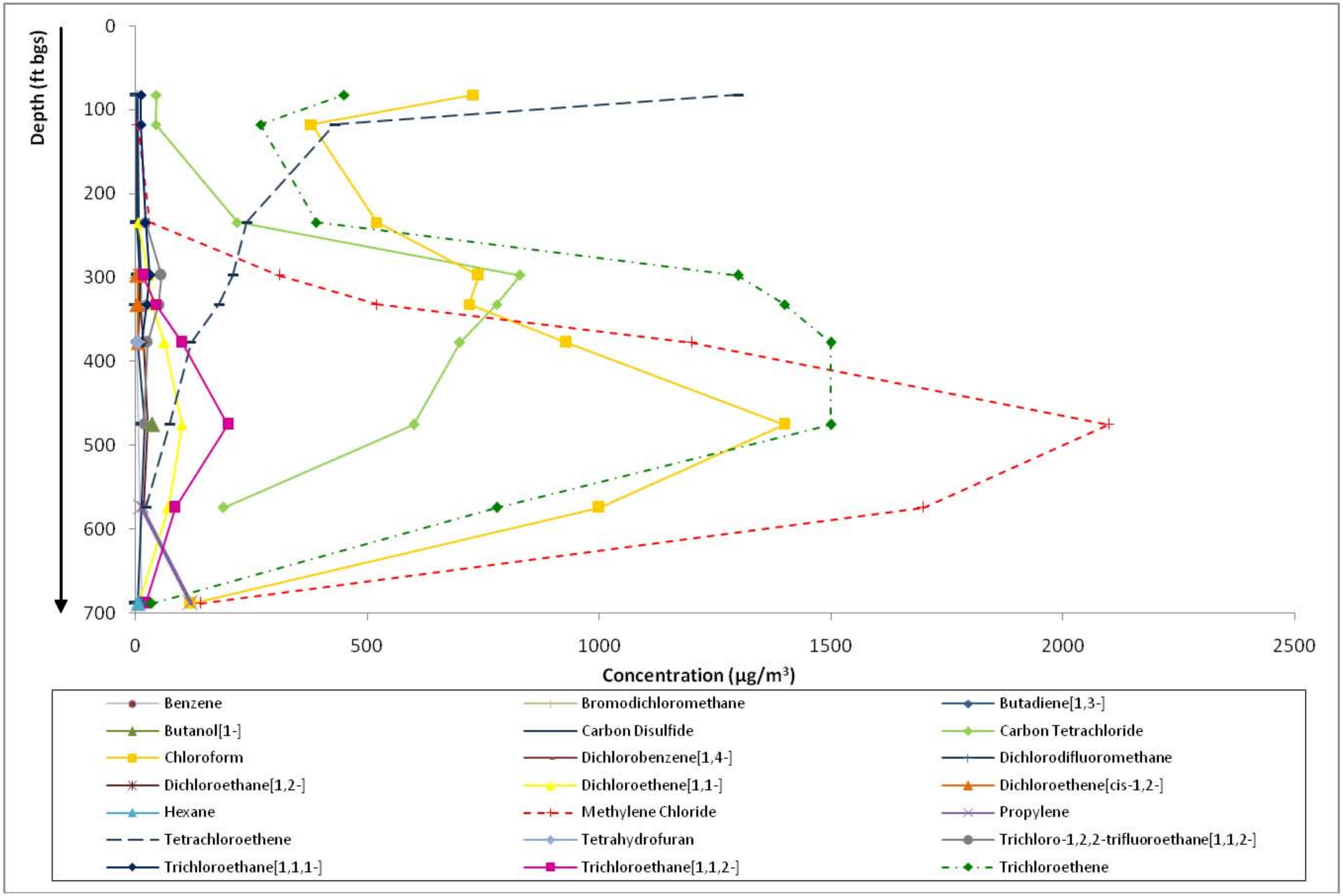


Figure 5.1-8 Vertical profile of detected VOCs in vapor-monitoring well 21-25262, round 8, July 2009

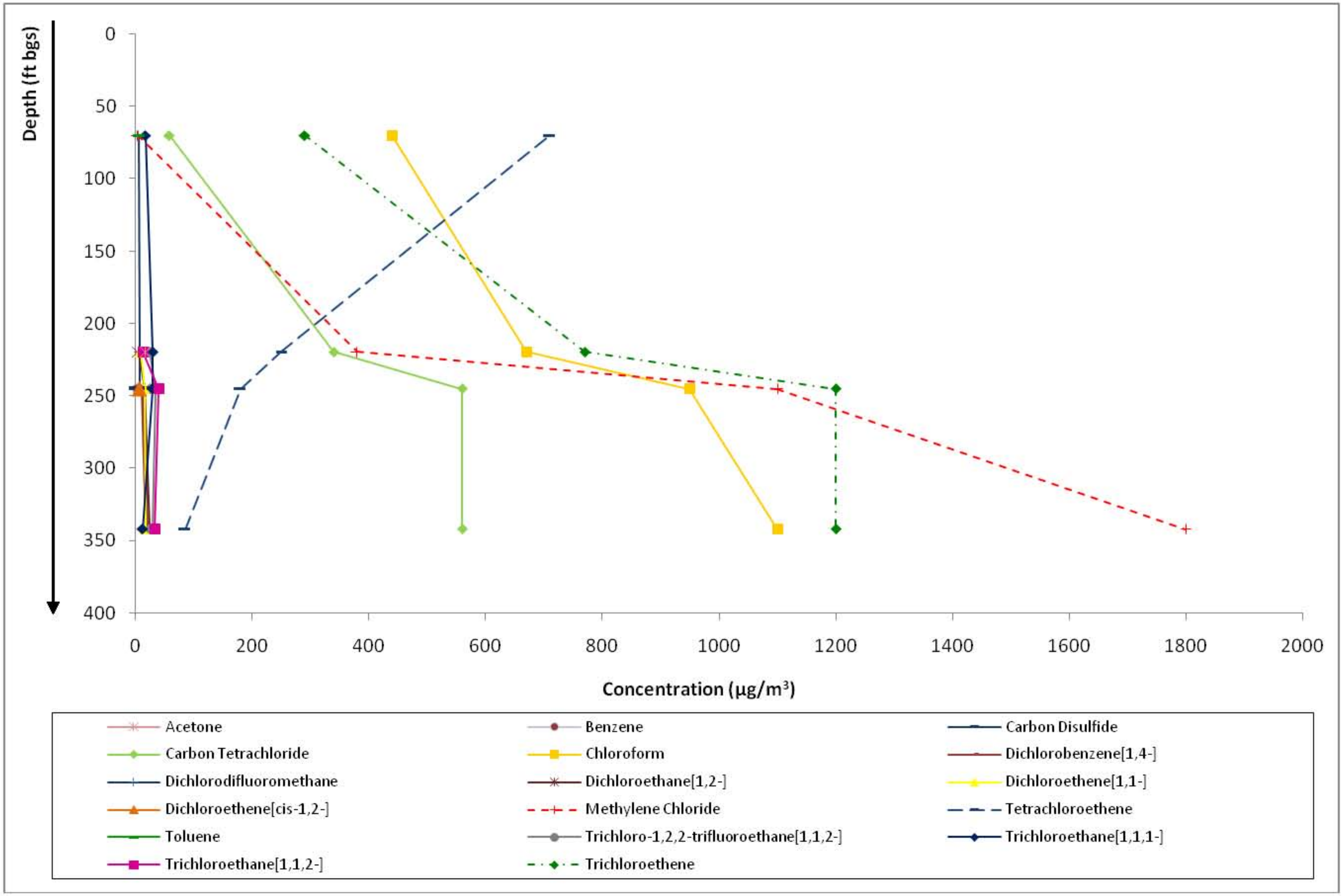


Figure 5.1-9 Vertical profile of detected VOCs in vapor-monitoring well 21-603058, round 9, August 2009

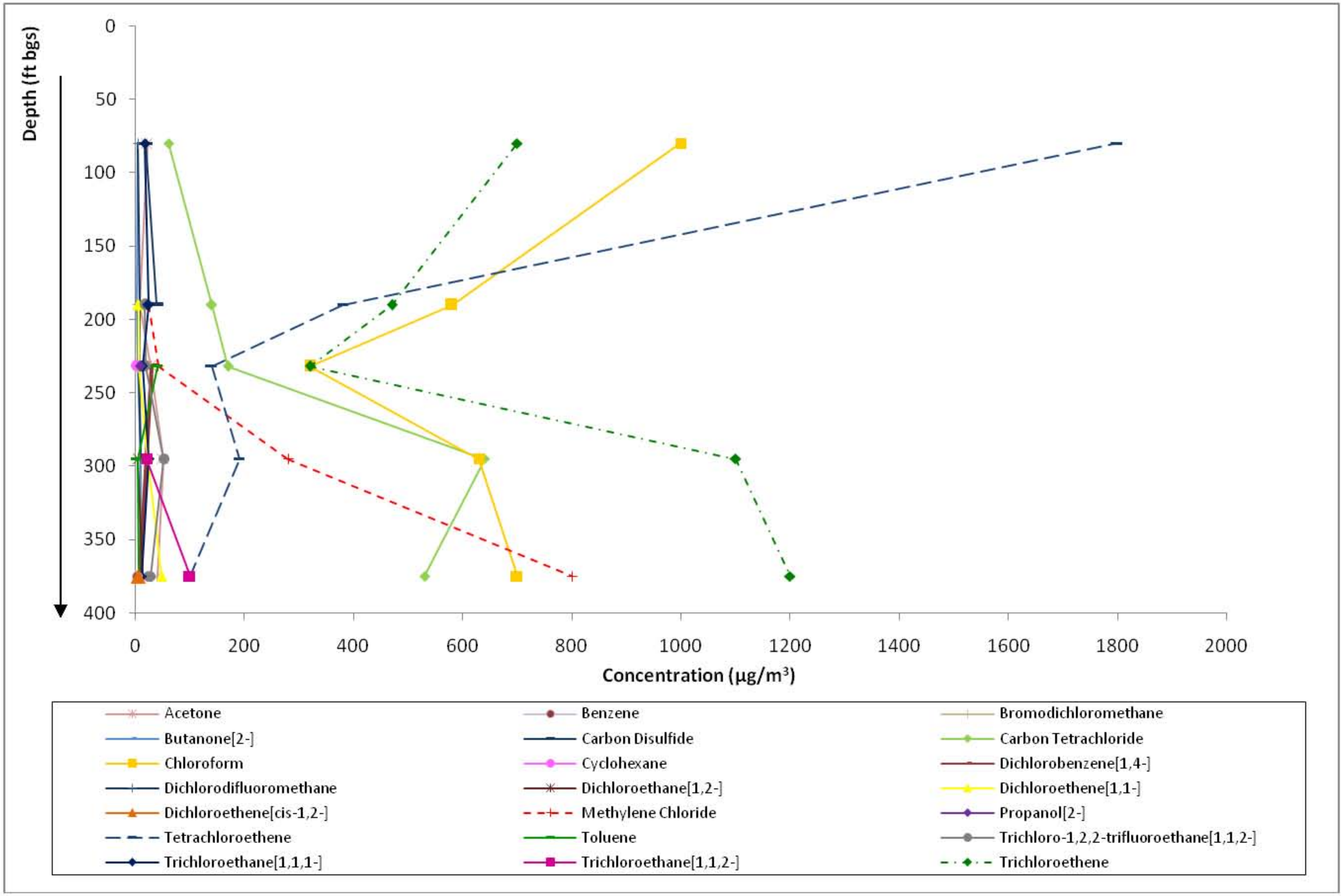


Figure 5.1-10 Vertical profile of detected VOCs in vapor-monitoring well 21-603059, round 9, August 2009

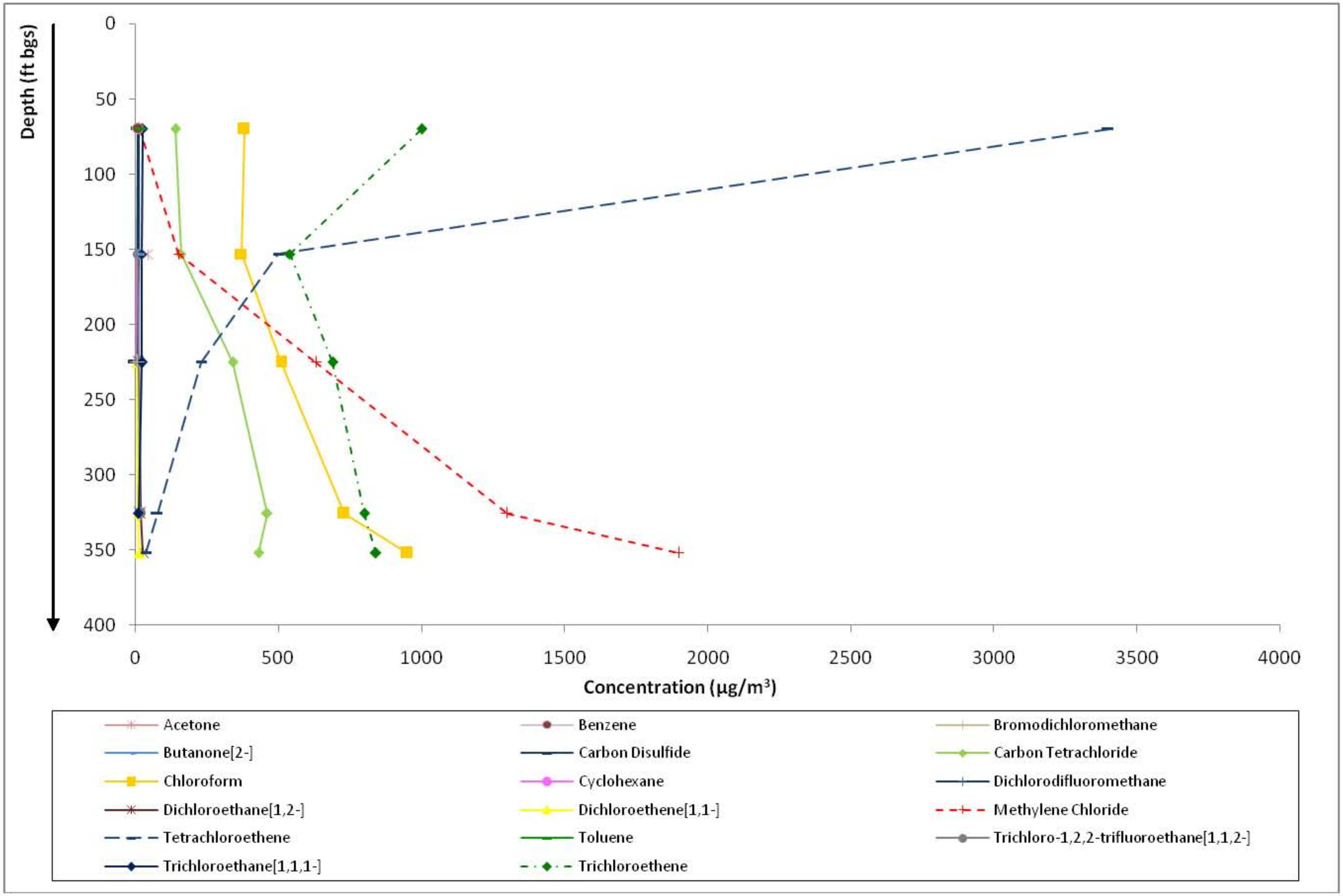


Figure 5.1-11 Vertical profile of detected VOCs in vapor-monitoring well 21-25264, round 9, August 2009

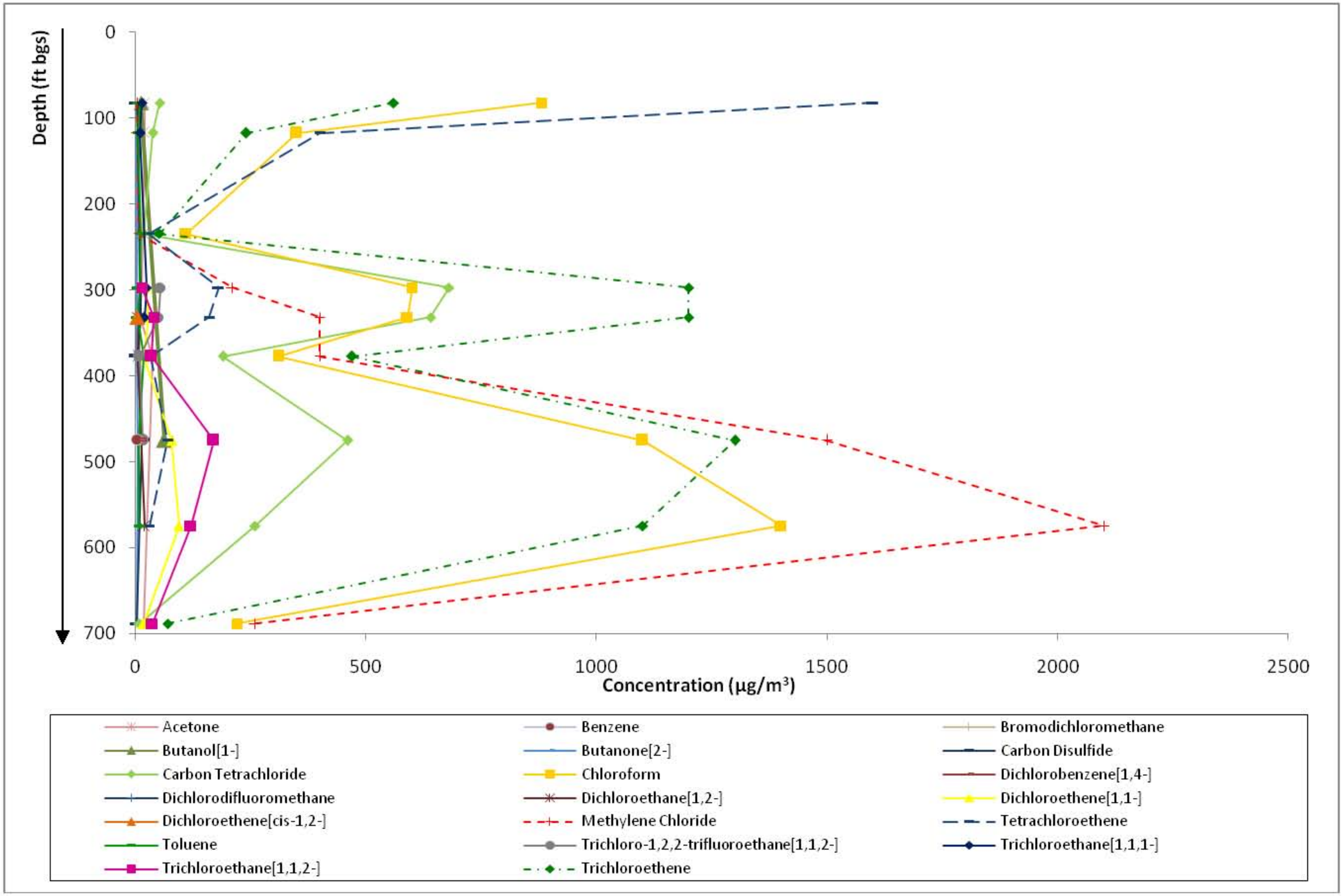


Figure 5.1-12 Vertical profile of detected VOCs in vapor-monitoring well 21-25262, round 9, August 2009

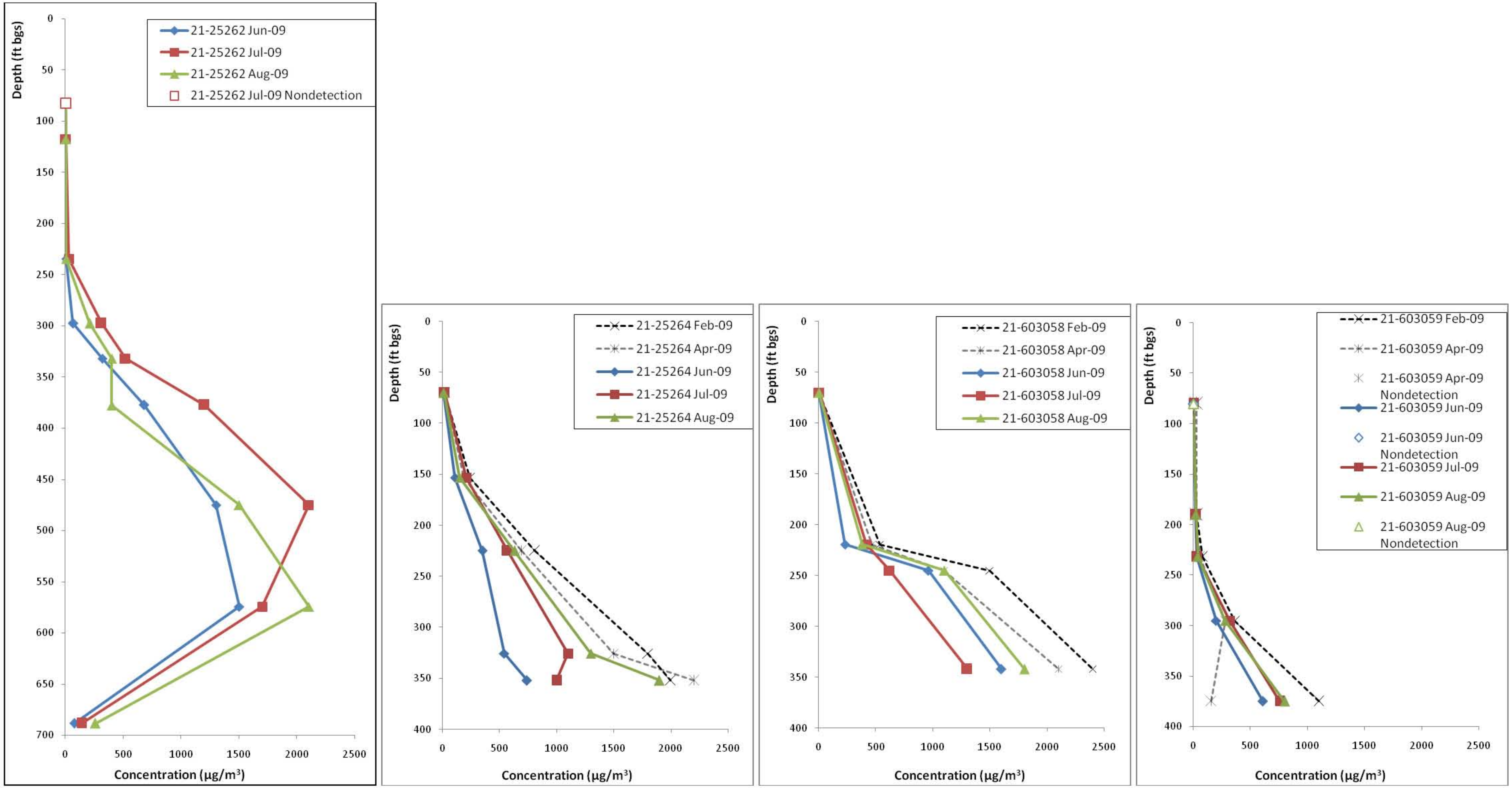


Figure 5.1-13 Vertical profile of methylene chloride in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, June 2009–August 2009

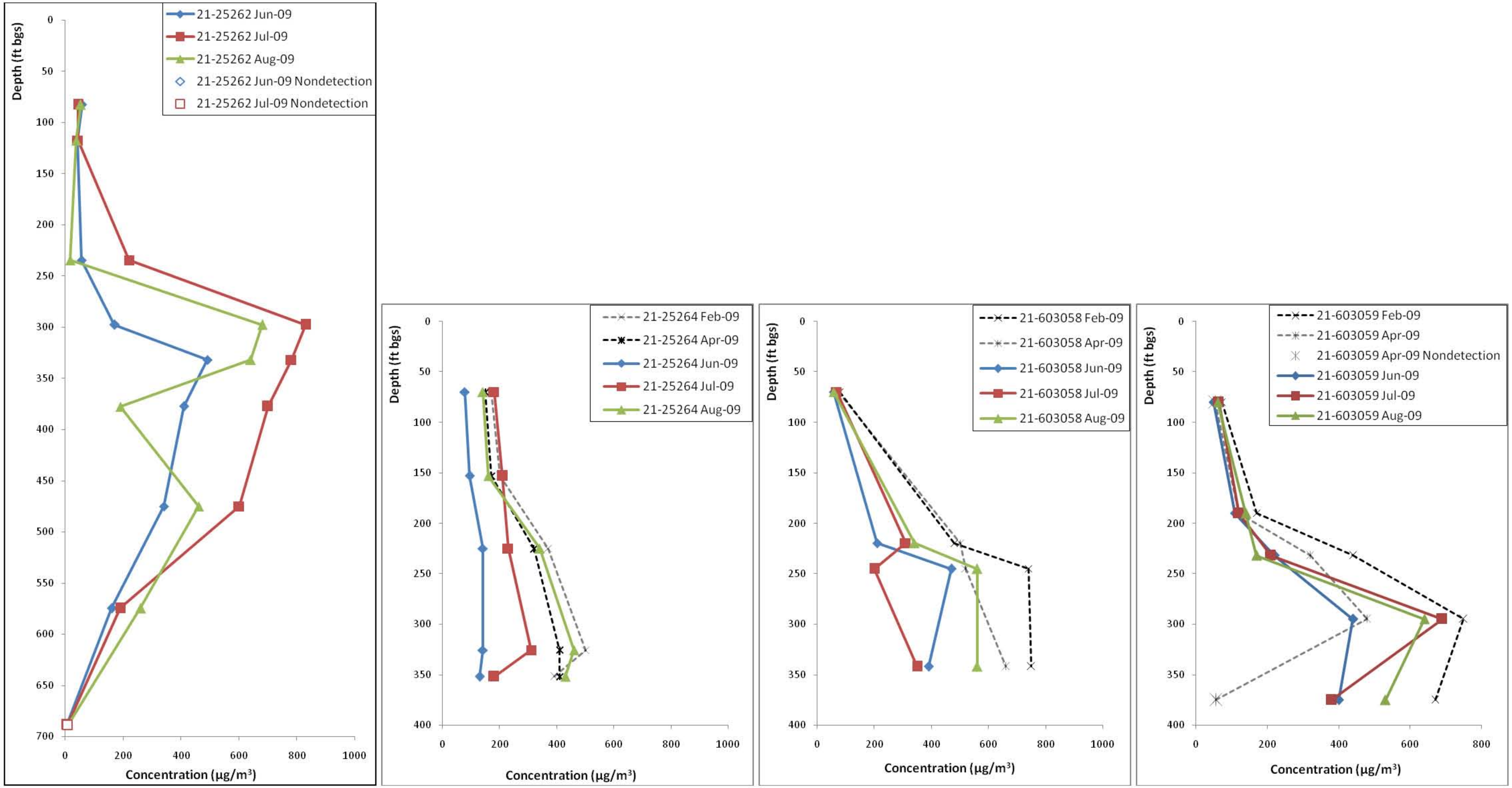


Figure 5.1-14 Vertical profile of carbon tetrachloride in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, June 2009–August 2009

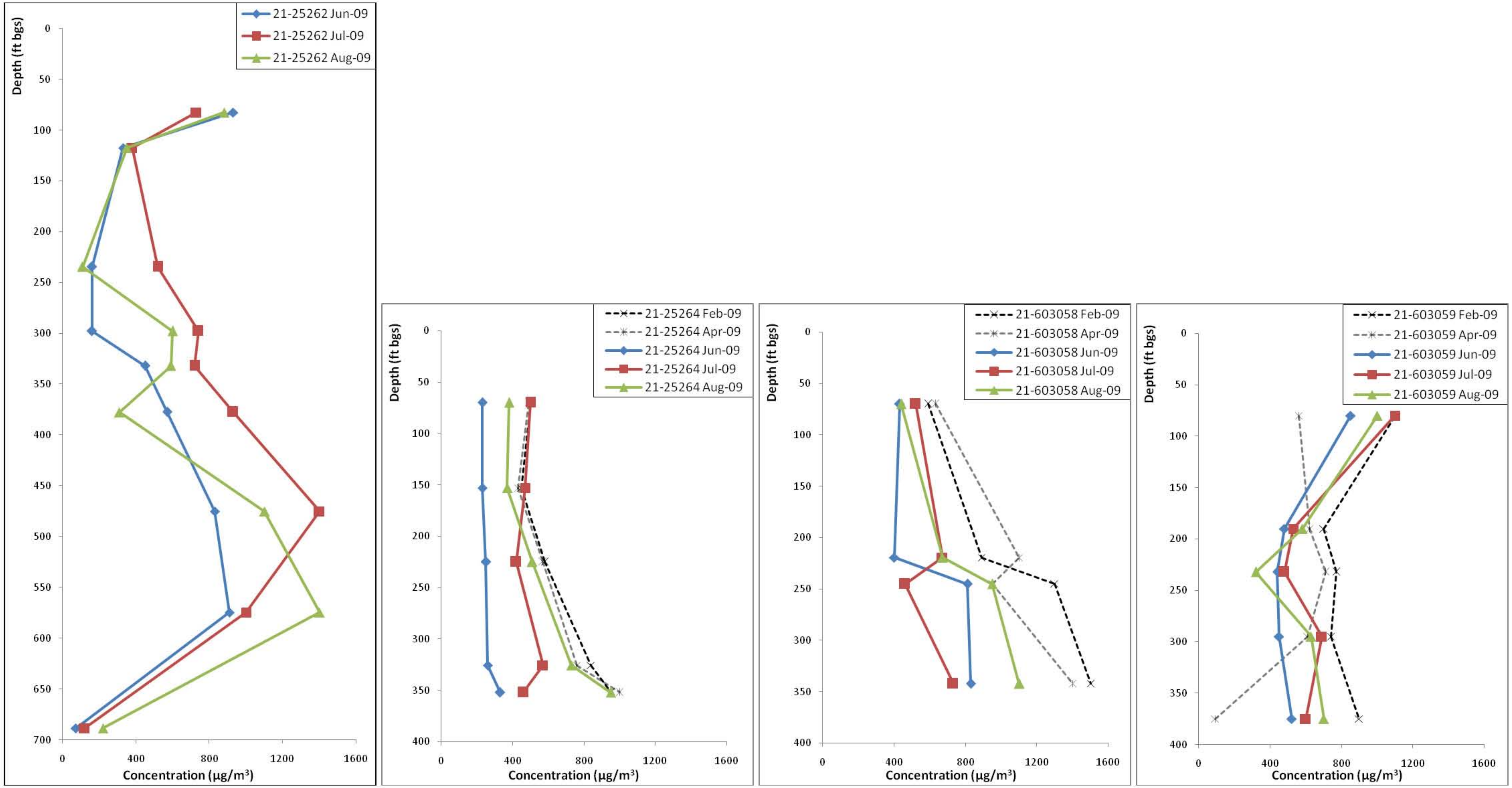


Figure 5.1-15 Vertical profile of chloroform in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, June 2009–August 2009

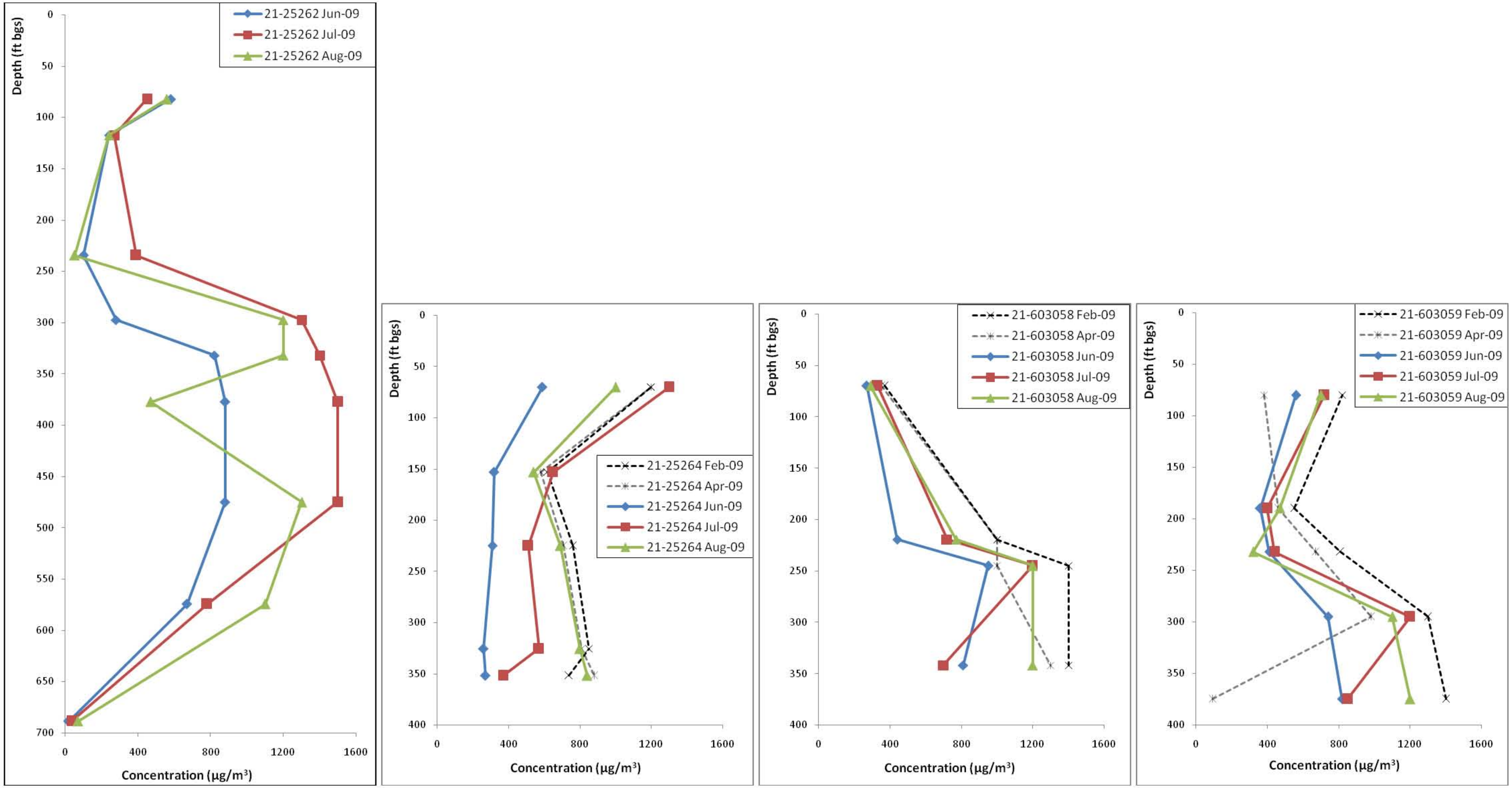


Figure 5.1-16 Vertical profile of TCE in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, June 2009–August 2009

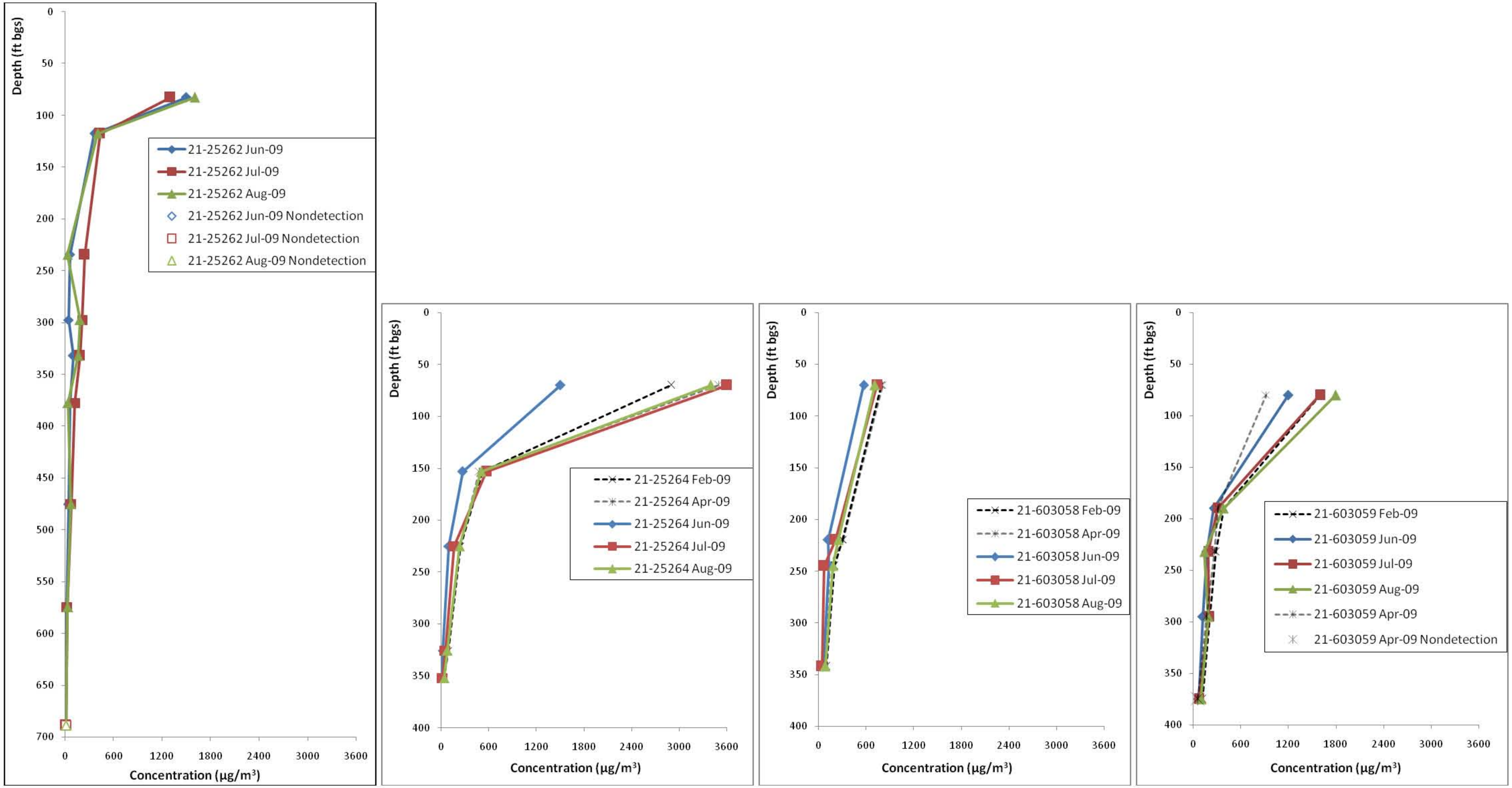


Figure 5.1-17 Vertical profile of PCE in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, June 2009–August 2009

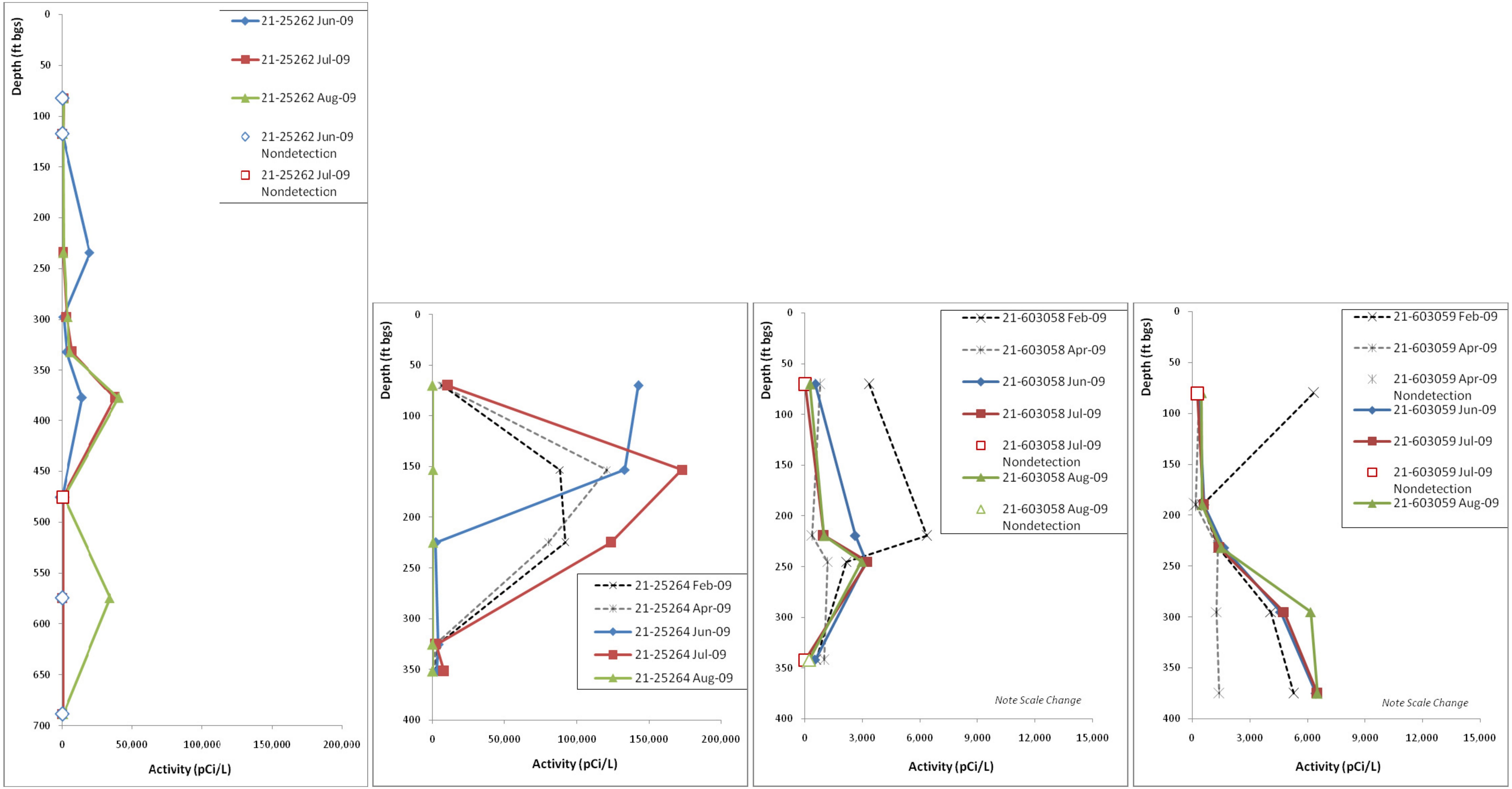


Figure 5.3-1 Vertical profile of tritium in vapor-monitoring wells 21-25262, 21-25264, 21-603058, and 21-603059, June 2009–August 2009

Table 2.0-1
MDA T Pore-Gas Sampling Depths and Collection Dates, June–August 2009

Vapor-Monitoring Well ID	Sampling Port	Begin Depth (ft bgs)	End Depth (ft bgs)	June 2009, Round 7 Collection Date (Event ID 877)	July 2009, Round 8 Collection Date (Event ID 912)	August 2009, Round 9 Collection Date (Event ID 2192)
21-25262	1	80	85	6/12/2009	7/14/2009	8/11/2009
21-25262	2	115	120	6/12/2009	7/14/2009	8/11/2009
21-25262	3	232	237	6/12/2009	7/14/2009	8/11/2009
21-25262	4	295	300	6/12/2009	7/14/2009	8/13/2009
21-25262	5	329.5	334.5	6/12/2009	7/14/2009	8/13/2009
21-25262	6	375	380	6/12/2009	7/14/2009	8/11/2009
21-25262	7	472.25	478	6/12/2009	7/14/2009	8/13/2009
21-25262	8	572	577	6/12/2009	7/14/2009	8/14/2009
21-25262	9	686	691	6/15/2009	7/14/2009	8/13/2009
21-25264	1	67.5	72.5	6/17/2009	7/17/2009	8/19/2009
21-25264	2	150.5	155.5	6/17/2009	7/17/2009	8/19/2009
21-25264	3	222.5	227.5	6/17/2009	7/17/2009	8/19/2009
21-25264	4	323	328	6/17/2009	7/17/2009	8/19/2009
21-25264	5	349.5	354.5	6/17/2009	7/17/2009	8/19/2009
21-603058	1	67.5	72.5	6/18/2009	7/16/2009	8/18/2009
21-603058	2	160.5	165.5	—*	—	—
21-603058	3	217	222	6/18/2009	7/16/2009	8/18/2009
21-603058	4	242.5	247.5	6/18/2009	7/16/2009	8/18/2009
21-603058	5	339.5	344.5	6/18/2009	7/16/2009	8/18/2009
21-603059	1	77.5	82.5	6/16/2009	7/15/2009	8/14/2009
21-603059	2	112.5	117.5	—	—	—
21-603059	3	187.5	192.5	6/16/2009	7/15/2009	8/14/2009
21-603059	4	229.5	234.5	6/16/2009	7/15/2009	8/14/2009
21-603059	5	292.5	297.5	6/16/2009	7/15/2009	8/14/2009
21-603059	6	372.5	377.5	6/16/2009	7/15/2009	8/14/2009

Note: Event IDs refer to the SCL and COC packages provided in Appendix D.

* — = Sample not collected. See section 2.1 for further explanation.

Table 2.0-2
Summary of Pore-Gas Samples Collected at MDA T, June–August 2009

Sample ID	Vapor-Monitoring Well ID	Depth (ft)	Collection Date	Field QC Type	Tritium	VOCs
MD21-09-10355	21-25262	80–85	6/12/2009	n/a[a]	09-2321	09-2320
MD21-09-10356	21-25262	115–120	6/12/2009	n/a	09-2321	09-2320
MD21-09-10357	21-25262	232–237	6/12/2009	n/a	09-2321	09-2320
MD21-09-10358	21-25262	295–300	6/12/2009	n/a	09-2321	09-2320
MD21-09-10359	21-25262	329.5–334.5	6/12/2009	n/a	09-2334	09-2333
MD21-09-10360	21-25262	375–380	6/12/2009	n/a	09-2334	09-2333
MD21-09-10361	21-25262	472.25–478	6/12/2009	n/a	09-2334	09-2333
MD21-09-10362	21-25262	572–577	6/12/2009	n/a	09-2334	09-2333
MD21-09-10363	21-25262	686–691	6/15/2009	n/a	09-2334	09-2333
MD21-09-10364	21-25262	686–691	6/15/2009	FD	09-2334	09-2333
MD21-09-11294	21-25262	80–85	7/14/2009	n/a	09-2636	09-2635
MD21-09-11295	21-25262	115–120	7/14/2009	n/a	09-2636	09-2635
MD21-09-11296	21-25262	232–237	7/14/2009	n/a	09-2636	09-2635
MD21-09-11297	21-25262	295–300	7/14/2009	n/a	09-2636	09-2635
MD21-09-11298	21-25262	329.5–334.5	7/14/2009	n/a	09-2636	09-2635
MD21-09-11299	21-25262	375–380	7/14/2009	n/a	09-2636	09-2635
MD21-09-11300	21-25262	472.25–478	7/14/2009	n/a	09-2636	09-2635
MD21-09-11301	21-25262	572–577	7/14/2009	n/a	09-2636	09-2635
MD21-09-11302	21-25262	686–691	7/14/2009	n/a	09-2636	09-2635
MD21-09-11303	21-25262	n/a	7/14/2009	FB	—[b]	09-2635
MD21-09-11304	21-25262	686–691	7/14/2009	FD	09-2636	09-2635
MD21-09-11488	21-25262	80–85	8/11/2009	n/a	09-2853	09-2852
MD21-09-11489	21-25262	115–120	8/11/2009	n/a	09-2853	09-2852
MD21-09-11490	21-25262	232–237	8/11/2009	n/a	09-2853	09-2852
MD21-09-11491	21-25262	295–300	8/13/2009	n/a	09-2882	09-2881
MD21-09-11492	21-25262	329.5–334.5	8/13/2009	n/a	09-2882	09-2881
MD21-09-11493	21-25262	375–380	8/11/2009	n/a	09-2853	09-2852
MD21-09-11494	21-25262	472.25–478	8/13/2009	n/a	09-2882	09-2881
MD21-09-11495	21-25262	572–577	8/14/2009	n/a	09-2885	09-2884
MD21-09-11496	21-25262	686–691	8/13/2009	n/a	09-2885	09-2884
MD21-09-11497	21-25262	686–691	8/14/2009	FD	09-2885	09-2884
MD21-09-11498	21-25262	n/a	8/11/2009	FB	—	09-2852
MD21-09-10354	21-25264	n/a	6/18/2009	FB	—	09-2406
MD21-09-10344	21-25264	67.5–72.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-10345	21-25264	150.5–155.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-10353	21-25264	150.5–155.5	6/17/2009	FD	09-2363	09-2362

Table 2.0-2 (continued)

Sample ID	Vapor-Monitoring Well ID	Depth (ft)	Collection Date	Field QC Type	Tritium	VOCs
MD21-09-10346	21-25264	222.5–227.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-10347	21-25264	323–328	6/17/2009	n/a	09-2363	09-2362
MD21-09-10348	21-25264	349.5–354.5	6/17/2009	n/a	09-2363	09-2362
MD21-09-11292	21-25264	n/a	7/17/2009	FB	—	09-2683
MD21-09-11283	21-25264	67.5–72.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11284	21-25264	150.5–155.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11293	21-25264	150.5–155.5	7/17/2009	FD	09-2684	09-2683
MD21-09-11285	21-25264	222.5–227.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11286	21-25264	323–328	7/17/2009	n/a	09-2684	09-2683
MD21-09-11287	21-25264	349.5–354.5	7/17/2009	n/a	09-2684	09-2683
MD21-09-11477	21-25264	67.5–72.5	8/19/2009	n/a	09-2947	09-2946
MD21-09-11478	21-25264	150.5–155.5	8/19/2009	n/a	09-2947	09-2946
MD21-09-11486	21-25264	150.5–155.5	7/17/2009	FD	09-2947	09-2946
MD21-09-11479	21-25264	222.5–227.5	8/19/2009	n/a	09-2947	09-2946
MD21-09-11480	21-25264	323–328	8/19/2009	n/a	09-2947	09-2946
MD21-09-11481	21-25264	349.5–354.5	8/19/2009	n/a	09-2947	09-2946
MD21-09-11483	21-25264	n/a	8/19/2009	FB	—	09-2946
MD21-09-10352	21-603058	n/a	6/18/2009	FB	—	09-2406
MD21-09-10339	21-603058	67.5–72.5	6/18/2009	n/a	09-2407	09-2406
MD21-09-10341	21-603058	217–222	6/18/2009	n/a	09-2407	09-2406
MD21-09-10351	21-603058	217–222	6/18/2009	FD	09-2407	09-2406
MD21-09-10342	21-603058	242.5–247.5	6/18/2009	n/a	09-2407	09-2406
MD21-09-10343	21-603058	339.5–344.5	6/18/2009	n/a	09-2407	09-2406
MD21-09-11290	21-603058	n/a	7/16/2009	FB	—	09-2669
MD21-09-11278	21-603058	67.5–72.5	7/16/2009	n/a	09-2670	09-2669
MD21-09-11280	21-603058	217–222	7/16/2009	n/a	09-2670	09-2669
MD21-09-11291	21-603058	217–222	7/16/2009	FD	09-2670	09-2669
MD21-09-11281	21-603058	242.5–247.5	7/16/2009	n/a	09-2670	09-2669
MD21-09-11282	21-603058	339.5–344.5	7/16/2009	n/a	09-2670	09-2669
MD21-09-11485	21-603058	n/a	8/18/2009	FB	—	09-2919
MD21-09-11472	21-603058	67.5–72.5	8/18/2009	n/a	09-2920	09-2919
MD21-09-11473	21-603058	217–222	8/18/2009	n/a	09-2920	09-2919
MD21-09-11484	21-603058	217–222	8/18/2009	FD	09-2920	09-2919
MD21-09-11474	21-603058	242.5–247.5	8/18/2009	n/a	09-2920	09-2919
MD21-09-11475	21-603058	339.5–344.5	8/18/2009	n/a	09-2920	09-2919
MD21-09-10350	21-603059	n/a	6/18/2009	FB	—	09-2406
MD21-09-10333	21-603059	77.5–82.5	6/16/2009	n/a	09-2343	09-2342

Table 2.0-2 (continued)

Sample ID	Vapor-Monitoring Well ID	Depth (ft)	Collection Date	Field QC Type	Tritium	VOCs
MD21-09-10334	21-603059	187.5–192.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10335	21-603059	229.5–234.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10336	21-603059	292.5–297.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-10349	21-603059	292.5–297.5	6/16/2009	FD	09-2343	09-2342
MD21-09-10337	21-603059	372.5–377.5	6/16/2009	n/a	09-2343	09-2342
MD21-09-11272	21-603059	77.5–82.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11273	21-603059	187.5–192.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11274	21-603059	229.5–234.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11275	21-603059	292.5–297.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11276	21-603059	372.5–377.5	7/15/2009	n/a	09-2655	09-2654
MD21-09-11289	21-603059	372.5–377.5	7/15/2009	FD	09-2655	09-2654
MD21-09-11469	21-603059	77.5–82.5	8/14/2009	n/a	09-2901	09-2900
MD21-09-11470	21-603059	187.5–192.5	8/14/2009	n/a	09-2901	09-2900
MD21-09-11471	21-603059	229.5–234.5	8/14/2009	n/a	09-2901	09-2900
MD21-09-11468	21-603059	292.5–297.5	8/14/2009	n/a	09-2901	09-2900
MD21-09-11467	21-603059	372.5–377.5	8/14/2009	n/a	09-2901	09-2900
MD21-09-11482	21-603059	372.5–377.5	8/14/2009	FD	09-2901	09-2900

Note: Numbers in analyte columns are request numbers.

[a] n/a = Not applicable.

[b] — = Sample not collected.

Table 2.0-3
Barometric Pressure, Relative Humidity, and Temperature at Los Alamos Airport during Sample Collection, June–August 2009

Sampling Round	Date/Time of Measurement	Barometric Pressure (in. Hg)	Relative Humidity (%)	Temperature (°F)
7	6/15/09 at 12:10	30.16[a]	NR[b]	NR
	6/16/09 at 09:10	30.19	21	64
	6/17/09 at 08:30	30.21	24	64
	6/18/09 at 10:30	30.13	19	72
8	7/13/09 at 10:30	30.35	21	77
	7/14/09 at 09:30	30.30	22	77
	7/14/09 at 15:30	30.24	8	86
	7/15/09 at 10:10	30.39	12	81
	7/15/09 at 13:30	30.36	7	84
	7/16/09 at 12:30	30.45	36	73
	7/17/09 at 10:30	30.46	21	81
9	8/11/09 at 09:50	30.47	27	70
	8/11/09 at 15:10	30.39	15	82
	8/12/09 at 09:30	30.46	60	64
	8/13/09 at 14:10	30.28	26	81
	8/13/09 at 15:00	30.25	26	81
	8/14/09 at 07:30	30.27	100	54
	8/14/09 at 13:50	30.26	94	59
	8/17/09 at 09:10	30.30	28	66
	8/17/09 at 14:50	30.25	13	81
	8/18/09 at 07:50	30.27	49	64
	8/18/09 at 09:30	30.28	49	68
	8/19/09 at 07:30	30.16	22	61
	8/19/09 at 09:10	30.16	20	68

[a] Data obtained from http://www.srh.noaa.gov/data/obhistory/KLAM.html.

[b] NR = Not recorded.

Table 3.0-1
Henry's Law Constants, Groundwater SLs, and Calculated Concentrations Corresponding to Groundwater SLs for Detected VOCs in Pore Gas

VOC	Henry's Law Constant[a] (dimensionless)	Groundwater Screening Level (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard[b] ($\mu g/m^3$)
Acetone	0.0016	22,000[c]	35,200
Benzene	0.228	5[d]	1,140
Bromodichloromethane	0.087	1.2[c]	104
1,3-Butadiene	3	0.18[c]	540
1-Butanol	0.00036[c]	3700[c]	1,332
2-Butanone	0.0023	7100[c]	16,330
Carbon Disulfide	0.59	1000[c]	590,000
Carbon Tetrachloride	1.1	5[d]	5,500
Chloroform	0.15	100[e]	15,000
Cyclohexane	6.1[b]	13,000[c]	79,300,000
1,2-Dichlorobenzene	0.0779	600[d]	46,740
1,4-Dichlorobenzene	0.0996	75[d]	7,470
Dichlorodifluoromethane	14	390[c]	5,460,000
1,2-Dichloroethane	0.048	5[d]	240
1,1-Dichloroethene	1.1	5[e]	5,500
cis-1,2-Dichloroethane	0.17	70[d]	11,900
Hexane	74	880[c]	65,120,000
Methylene chloride	0.13	5[d]	650
2-Propanol	na[f]	na	na
Propylene	na	na	na
Tetrachloroethene	0.72	5[d]	3,600
Tetrahydrofuran	na	na	na
Toluene	0.272	750[e]	204,000
1,1,2-Trichloro-1,2,2-trifluoroethane	22	59,000[c]	1,298,000,000
1,1,1-Trichloroethane	0.705	60[e]	42,300
1,1,2-Trichloroethane	0.034	5[d]	170
Trichloroethene	0.4	5[d]	2,000
1,3-Xylene+1,4-Xylene	0.27	620[e]	167,400

[a] From NMED (2009, 106420, Appendix B) unless otherwise noted.

[b] Derived from denominator of Equation 5.0-3.

[c] Henry's law constant and tap water screening levels from EPA regional screening tables (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm).

[d] EPA MCL (40 Code of Federal Regulations 141.61).

[e] NMWQCC groundwater standard (20.6.2.3103 New Mexico Administrative Code).

[f] na = Not available.

Table 4.0-1
Summary of Pore-Gas Field-Screening Results, June–August 2009

Event ID	Collection Date	Sampling Round	Location ID	Sampling Port Number	Top Depth (ft bgs)	Bottom Depth (ft bgs)	Percent (%) CO_2	Percent (%) O_2
877	6/12/2009	7	21-25262	1	80	85	0.7	19.8
912	7/14/2009	8	21-25262	1	80	85	0.6	19.8
2192	8/11/2009	9	21-25262	1	80	85	0.5	17.4
877	6/12/2009	7	21-25262	2	115	120	0.5	20.1
912	7/14/2009	8	21-25262	2	115	120	0.4	20.2
2192	8/11/2009	9	21-25262	2	115	120	0.2	17.4
877	6/12/2009	7	21-25262	3	232	237	0.0	20.6
912	7/14/2009	8	21-25262	3	232	237	0.6	20.0
2192	8/11/2009	9	21-25262	3	232	237	0.0	17.5
877	6/12/2009	7	21-25262	4	295	300	0.0	20.6
912	7/14/2009	8	21-25262	4	295	300	0.8	19.9
2192	8/13/2009	9	21-25262	4	295	300	0.6	16.5
877	6/12/2009	7	21-25262	5	329.5	334.5	0.5	19.5
912	7/14/2009	8	21-25262	5	329.5	334.5	0.7	19.9
2192	8/13/2009	9	21-25262	5	329.5	334.5	0.5	16.5
877	6/12/2009	7	21-25262	6	375	380	0.4	19.9
912	7/14/2009	8	21-25262	6	375	380	0.4	20.2
2192	8/11/2009	9	21-25262	6	375	380	0.0	17.2
877	6/12/2009	7	21-25262	7	472.25	478	0.2	19.9
912	7/14/2009	8	21-25262	7	472.25	478	0.2	20.2
2192	8/13/2009	9	21-25262	7	472.25	478	0.1	16.6
877	6/12/2009	7	21-25262	8	572	577	0.1	19.2
912	7/14/2009	8	21-25262	8	572	577	0.0	20.7
2192	8/14/2009	9	21-25262	8	572	577	0.0	17.3
877	6/12/2009	7	21-25262	9	686	691	0.0	19.5
912	7/14/2009	8	21-25262	9	686	691	0.0	20.7
2192	8/13/2009	9	21-25262	9	686	691	0.0	17.3
877	6/17/2009	7	21-25264	1	67.5	72.5	0.7	19.9
912	7/17/2009	8	21-25264	1	67.5	72.5	0.7	19.4
2192	8/19/2009	9	21-25264	1	67.5	72.5	0.7	16.5
877	6/17/2009	7	21-25264	2	150.5	155.5	0.6	20.3
912	7/17/2009	8	21-25264	2	150.5	155.5	0.8	19.5
2192	8/19/2009	9	21-25264	2	150.5	155.5	0.7	16.5
877	6/17/2009	7	21-25264	3	222.5	227.5	0.4	20.7
912	7/17/2009	8	21-25264	3	222.5	227.5	0.4	19.9
2192	8/19/2009	9	21-25264	3	222.5	227.5	0.6	16.1

Table 4.0-1 (continued)

Event ID	Collection Date	Sampling Round	Location ID	Sampling Port Number	Top Depth (ft bgs)	Bottom Depth (ft bgs)	Percent (%) CO_2	Percent (%) O_2
877	6/17/2009	7	21-25264	4	323	328	0.0	20.8
912	7/17/2009	8	21-25264	4	323	328	0.3	20.0
2192	8/19/2009	9	21-25264	4	323	328	0.4	16.0
877	6/17/2009	7	21-25264	5	349.5	354.5	0.0	20.7
912	7/17/2009	8	21-25264	5	349.5	354.5	0.1	20.0
2192	8/19/2009	9	21-25264	5	349.5	354.5	0.3	15.5
877	6/18/2009	7	21-603058	1	67.5	72.5	0.0	20.6
912	7/16/2009	8	21-603058	1	67.5	72.5	0.7	19.4
2192	8/18/2009	9	21-603058	1	67.5	72.5	0.6	16.9
877	6/18/2009	7	21-603058	3	217	222	0.5	20.4
912	7/16/2009	8	21-603058	3	217	222	0.5	20.0
2192	8/18/2009	9	21-603058	3	217	222	0.5	17.1
877	6/18/2009	7	21-603058	4	242.5	247.5	0.7	20.1
912	7/16/2009	8	21-603058	4	242.5	247.5	0.2	20.1
2192	8/18/2009	9	21-603058	4	242.5	247.5	0.5	17.1
877	6/18/2009	7	21-603058	5	339.5	344.5	0.6	20.0
912	7/16/2009	8	21-603058	5	339.5	344.5	0.4	19.9
2192	8/18/2009	9	21-603058	5	339.5	344.5	0.6	16.7
877	6/16/2009	7	21-603059	1	77.5	82.5	0.7	19.6
912	7/15/2009	8	21-603059	1	77.5	82.5	0.6	19.7
2192	8/14/2009	9	21-603059	1	77.5	82.5	0.6	17.0
877	6/16/2009	7	21-603059	3	187.5	192.5	0.5	19.9
912	7/15/2009	8	21-603059	3	187.5	192.5	0.5	19.8
2192	8/14/2009	9	21-603059	3	187.5	192.5	0.6	16.9
877	6/16/2009	7	21-603059	4	229.5	234.5	0.6	20.1
912	7/15/2009	8	21-603059	4	229.5	234.5	0.4	20.1
2192	8/14/2009	9	21-603059	4	229.5	234.5	0.8	16.8
877	6/16/2009	7	21-603059	5	292.5	297.5	0.4	20.5
912	7/15/2009	8	21-603059	5	292.5	297.5	0.5	19.6
2192	8/14/2009	9	21-603059	5	292.5	297.5	0.6	16.6
877	6/16/2009	7	21-603059	6	372.5	377.5	0.3	20.0
912	7/15/2009	8	21-603059	6	372.5	377.5	0.1	19.7
2192	8/14/2009	9	21-603059	6	372.5	377.5	0.2	16.7

Table 5.1-1
Summary of VOCs Detected in Pore-Gas Samples at MDA T, June–August 2009

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Butadiene[1,3-]	Butanol[1-]	Butanone[2-]	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	Dichlorobenzene[1,2-]	Dichlorobenzene[1,4-]	Dichlorodifluoromethane	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Hexane	Methylene Chloride	Propanol[2-]	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Xylene[1,3-]+Xylene[1,4-]
MD21-09-10355	21-25262	80–85	6/12/2009	—*	—	—	—	—	—	3.2	57	930	—	—	—	4.7	—	—	—	—	3.8	—	—	1500	—	—	—	17	—	580	—
MD21-09-11294	21-25262	80–85	7/14/2009	—	—	—	—	—	—	3.6	45	730	—	—	—	4.9	—	—	—	—	—	—	—	1300	—	—	—	12	—	450	—
MD21-09-11488	21-25262	80–85	8/11/2009	20	—	—	—	12 (J)	—	3.9	53	880	—	—	—	4.5	—	—	—	—	3.1	—	—	1600	—	8.9	—	14	—	560	—
MD21-09-10356	21-25262	115–120	6/12/2009	—	—	—	—	—	—	—	41	330	—	—	—	4.5	—	—	—	—	5.1	—	—	360	—	—	—	11	—	240	—
MD21-09-11295	21-25262	115–120	7/14/2009	—	—	—	—	—	—	—	44	380	—	—	—	4.9	—	—	—	—	5.8	—	—	430	—	—	—	12	—	270	—
MD21-09-11489	21-25262	115–120	8/11/2009	20	—	—	—	—	3.6	—	38	350	—	—	—	—	—	—	—	—	4.4	—	—	400	—	5.9	—	10	—	240	—
MD21-09-10357	21-25262	232–237	6/12/2009	37	—	—	—	—	4.4	—	56	160	—	—	—	—	—	—	—	—	8.1	—	—	57	—	—	—	5.8	—	100	—
MD21-09-11296	21-25262	232–237	7/14/2009	—	—	6.3	—	—	—	3.2	220	520	—	—	—	7.4	—	6	—	—	30	—	—	240	—	—	21	21	—	390	—
MD21-09-11490	21-25262	232–237	8/11/2009	16	—	—	—	—	—	—	17	110	—	—	—	—	—	—	—	—	7.2	—	—	29	—	12	—	—	—	52	—
MD21-09-10358	21-25262	295–300	6/12/2009	26	—	—	—	—	2.8	—	170	160	—	—	—	—	—	5.7	—	—	67	—	—	39	—	—	10	6.3	—	280	—
MD21-09-11297	21-25262	295–300	7/14/2009	—	—	11	—	—	—	8.2	830	740	—	—	—	11	5.1	29	4.5	—	310	—	—	210	—	—	56	31	16	1300	—
MD21-09-11491	21-25262	295–300	8/13/2009	13	—	8.5	—	—	3	11	680	600	—	—	—	9	—	22	—	—	210	—	—	180	—	8.8	54	24	14	1200	—
MD21-09-10359	21-25262	329.5–334.5	6/12/2009	12	—	7.8	—	—	—	6.2	490	450	—	—	—	6	6	20	3.6	—	320	—	—	97	—	—	27	16	24	820	—
MD21-09-11298	21-25262	329.5–334.5	7/14/2009	—	—	14	—	—	—	4.6	780	720	—	—	—	8.4	9.4	35	4.8	—	520	—	—	180	—	—	50	25	44	1400	—
MD21-09-11492	21-25262	329.5–334.5	8/13/2009	8.9	—	9.6	—	—	—	12	640	590	—	—	—	6.5	7.1	28	4.2	—	400	—	—	160	—	4.9	50	20	40	1200	—
MD21-09-10360	21-25262	375–380	6/12/2009	24	—	7.9	—	—	4.1	—	410	570	—	—	—	—	9.4	36	—	—	680	—	—	63	—	3.9	14	8.3	55	880	—
MD21-09-11299	21-25262	375–380	7/14/2009	—	3.9	15	—	—	—	5.1	700	930	—	—	7.4	5.1	17	62	5.5	—	1200	—	—	120	3.7	—	26	14	100	1500	—
MD21-09-11493	21-25262	375–380	8/11/2009	37	—	—	—	—	3.4	4.6	190	310	—	—	—	—	5.6	18	—	—	400	—	—	33	—	18	8.6	—	35	470	—
MD21-09-10361	21-25262	472.25–478	6/12/2009	14	—	—	—	—	—	4.9	340	830	—	—	—	—	16	61	—	—	1300	—	—	41	—	4.5	9.3	—	110	880	—
MD21-09-11300	21-25262	472.25–478	7/14/2009	—	—	—	—	36	—	19	600	1400	—	—	—	—	27	100	—	—	2100	—	—	74	—	—	18	—	200	1500	—
MD21-09-11494	21-25262	472.25–478	8/13/2009	—	4.8	9.1	—	62 (J)	4.9	14	460	1100	—	—	9.3	—	—	78	—	—	1500	—	—	70	—	8	16	—	170	1300	—
MD21-09-10362	21-25262	572–577	6/12/2009	—	—	—	—	—	—	5.2	160	910	—	—	—	—	15	63	—	—	1500	—	—	17	—	—	—	—	66	670	—
MD21-09-11301	21-25262	572–577	7/14/2009	—	—	—	—	—	—	—	190	1000	—	—	—	—	17	71	—	—	1700	—	13	23	—	—	—	—	85	780	—
MD21-09-11495	21-25262	572–577	8/14/2009	—	—	—	—	—	—	—	260	1400	—	—	—	—	20	94	—	—	2100	—	—	30	—	7.6	—	—	120	1100	—
MD21-09-10363	21-25262	686–691	6/15/2009	22	—	—	—	—	6	3.5	—	74	—	—	—	—	—	—	—	—	77	—	9.2	—	—	—	—	—	14	19	—
MD21-09-11302	21-25262	686–691	7/14/2009	—	13	—	7.4	—	—	4.8	—	120	—	—	—	—	—	7.1	—	5.6	140	—	120	—	—	—	—	—	21	34	—
MD21-09-11496	21-25262	686–691	8/14/2009	18	—	—	—	—	3.9	3.6	8.6	220	—	—	—	—	—	17	—	—	260	—	—	—	—	—	—	—	37	70	—
MD21-09-10344	21-25264	67.5–72.5	6/17/2009	11	—	—	—	—	—	—	77	230	—	—	—	8.4	—	—	—	—	9.5	—	—	1500	—	—	—	15	—	590	—
MD21-09-11283	21-25264	67.5–72.5	7/17/2009	—	—	—	—	—	—	—	180	500	—	—	—	17	—	—	—	—	18	—	—	3600	—	—	—	32	—	1300	—

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Butadiene[1,3-]	Butanol[1-]	Butanone[2-]	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	Dichlorobenzene[1,2-]	Dichlorobenzene[1,4-]	Dichlorodifluoromethane	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Hexane	Methylene Chloride	Propanol[2-]	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Xylene[1,3-]+Xylene[1,4-]
MD21-09-11477	21-25264	67.5–72.5	8/19/2009	—	11	—	—	—	—	8.2	140	380	—	—	—	12	—	—	—	—	14	—	—	3400	—	16	—	24	—	1000	—
MD21-09-10345	21-25264	150.5–155.5	6/17/2009	10	—	—	—	—	—	—	95	230	—	—	—	7.1	—	—	—	—	110	—	—	270	—	7.3	—	15	—	320	—
MD21-09-11284	21-25264	150.5–155.5	7/17/2009	—	—	—	—	—	—	—	210	470	—	—	—	14	3.9	—	—	—	210	—	—	570	—	—	8.3	30	—	650	—
MD21-09-11478	21-25264	150.5–155.5	8/19/2009	45	—	—	—	—	5.4	—	160	370	4.8	—	—	9.9	—	—	—	—	150	—	—	500	—	—	8.2	23	—	540	—
MD21-09-10346	21-25264	222.5–227.5	6/17/2009	10	—	—	—	—	—	—	140	250	—	—	—	5.9	5.4	—	—	—	350	—	—	94	—	8	—	11	—	310	—
MD21-09-11285	21-25264	222.5–227.5	7/17/2009	—	—	—	—	—	—	—	230	420	—	—	—	8.6	9.1	3.8	—	—	570	—	—	160	—	—	—	17	—	510	—
MD21-09-11479	21-25264	222.5–227.5	8/19/2009	—	—	5.9	—	—	—	4.3	340	510	6.3	—	—	9.2	10	5.7	—	—	630	—	—	230	—	—	12	23	—	690	—
MD21-09-10347	21-25264	323–328	6/17/2009	12	—	—	—	—	—	—	140	260	—	—	—	4.4	6.6	—	—	—	540	—	—	23	—	6.8	—	—	—	260	—
MD21-09-11286	21-25264	323–328	7/17/2009	—	—	—	—	—	9.6	—	310	570	—	—	5.2 (J)	7.1	16	7.8	—	—	1100	—	—	50	—	—	8.3	7.1	—	570	—
MD21-09-11480	21-25264	323–328	8/19/2009	—	—	—	—	—	—	—	460	730	—	—	—	—	18	8.7	—	—	1300	—	—	76	—	—	15	10	—	800	—
MD21-09-10348	21-25264	349.5–354.5	6/17/2009	34	—	—	—	—	5	—	130	330	—	—	—	—	9.6	4.4	—	—	740	—	—	10	—	5.9	—	—	—	270	—
MD21-09-11287	21-25264	349.5–354.5	7/17/2009	—	—	—	—	—	—	—	180	460	—	—	—	—	17	6.1	—	—	1000	—	—	18	—	—	—	—	—	370	—
MD21-09-11481	21-25264	349.5–354.5	8/19/2009	—	—	—	—	—	—	—	430	950	—	—	—	—	26	13	—	—	1900	—	—	36	—	—	—	—	—	840	—
MD21-09-10339	21-603058	67.5–72.5	6/18/2009	—	—	—	—	—	—	—	58	430	—	—	—	5	—	—	—	—	4.2	—	—	570	—	—	—	17	—	270	—
MD21-09-11278	21-603058	67.5–72.5	7/16/2009	29	—	—	—	—	4.8	—	68	520	—	—	—	5.8	—	—	—	—	5.6	—	—	740	—	14	—	20	—	330	—
MD21-09-11472	21-603058	67.5–72.5	8/18/2009	—	—	—	—	—	—	—	58	440	—	—	—	4.9	—	—	—	—	3.6	—	—	710	—	6.7	—	17	—	290	—
MD21-09-10341	21-603058	217–222	6/18/2009	—	—	—	—	—	—	—	210	400	—	—	—	5.3	—	5.2	—	—	230	—	—	120	—	—	12	19	6.8	440	—
MD21-09-11280	21-603058	217–222	7/16/2009	—	3.1	—	—	—	—	—	310	670	—	—	—	6.7	7.8	8	—	—	420	—	—	210	—	3.7	17	27	14	720	—
MD21-09-11473	21-603058	217–222	8/18/2009	16	—	—	—	—	—	—	340	670	—	—	—	6.6	5.3	8.5	—	—	380	—	—	250	—	—	24	30	13	770	—
MD21-09-10342	21-603058	242.5–247.5	6/18/2009	—	—	—	—	—	—	—	470	810	—	—	8.6	6.7	14	12	3.6	—	960	—	—	130	—	—	22	26	29	950	—
MD21-09-11281	21-603058	242.5–247.5	7/16/2009	15	—	—	—	—	5.4	29	200	460	—	83	16	5.2	8.9	6.2	—	—	620	—	—	68	—	4.8	9.5	12	17	1200	—
MD21-09-11474	21-603058	242.5–247.5	8/18/2009	—	3.2	—	—	—	—	3.4	560	950	—	—	13	7.8	16	15	6	—	1100	—	—	180	—	—	34	29	40	1200	—
MD21-09-10343	21-603058	339.5–344.5	6/18/2009	—	—	—	—	—	5.8	—	390	830	—	—	14	—	18	14	—	—	1600	—	—	57	—	—	23	—	23	810	—
MD21-09-11282	21-603058	339.5–344.5	7/16/2009	22	—	—	—	—	—	—	350	730	—	—	8.9	5	17	11	—	—	1300	—	—	44	—	—	16	7.7	18	700	—
MD21-09-11475	21-603058	339.5–344.5	8/18/2009	—	—	—	—	—	—	—	560	1100	—	—	19	—	25	17	—	—	1800	—	—	85	—	—	29	12	33	1200	—
MD21-09-10333	21-603059	77.5–82.5	6/16/2009	—	—	—	—	—	—	—	50	850	—	—	—	5.1	—	—	—	—	—	—	—	1200	—	—	—	16	—	560	—
MD21-09-11272	21-603059	77.5–82.5	7/15/2009	44	—	6.2	—	12	5.4	—	64	1100	—	—	—	5.9	—	—	—	—	4	—	—	1600	—	200	—	18	—	720	—
MD21-09-11469	21-603059	77.5–82.5	8/14/2009	22	—	—	—	—	4.6	18	61	1000	—	—	—	5.1	—	—	—	—	—	—	—	1800	—	—	—	17	—	700	—
MD21-09-10334	21-603059	187.5–192.5	6/16/2009	—	—	—	—	—	—	3.3	110	480	—	—	—	6.1	—	4.3	—	—	19	—	—	260	—	—	9.7	20	—	360	—
MD21-09-11273	21-603059	187.5–192.5	7/15/2009	43	—	6.2	—	—	5.4	—	120	530	—	—	—	7	—	5.5	—	5.5	24	—	—	310	—	21	14	22	—	400	—

Table 5.1-1 (continued)

Sample ID	Location ID	Depth (ft bgs)	Collection Date	Acetone	Benzene	Bromodichloromethane	Butadiene[1,3-]	Butanol[1-]	Butanone[2-]	Carbon Disulfide	Carbon Tetrachloride	Chloroform	Cyclohexane	Dichlorobenzene[1,2-]	Dichlorobenzene[1,4-]	Dichlorodifluoromethane	Dichloroethane[1,2-]	Dichloroethene[1,1-]	Dichloroethene[cis-1,2-]	Hexane	Methylene Chloride	Propanol[2-]	Propylene	Tetrachloroethene	Tetrahydrofuran	Toluene	1,1,2-Trichloro-1,2,2-trifluoroethane	Trichloroethane[1,1,1-]	Trichloroethane[1,1,2-]	Trichloroethene	Xylene[1,3-]+Xylene[1,4-]
MD21-09-11470	21-603059	187.5–192.5	8/14/2009	8.7	—	6.8	—	—	3.1	38	140	580	—	—	—	7	—	5.6	—	—	24	—	—	380	—	—	17	24	—	470	—
MD21-09-10335	21-603059	229.5–234.5	6/16/2009	—	—	—	—	—	2.7	—	220	440	—	—	—	6.2	—	8.8	—	—	29	—	—	170	—	—	20	19	—	410	—
MD21-09-11274	21-603059	229.5–234.5	7/15/2009	13	—	—	—	—	—	—	210	480	—	—	—	6.8	—	8.4	—	—	37	—	—	190	—	—	18	18	—	440	—
MD21-09-11471	21-603059	229.5–234.5	8/14/2009	28	—	—	—	—	5	—	170	320	4.1	—	30	5.2	—	6.4	—	—	42	8.3 (J)	—	140	—	40	18	13	—	320	—
MD21-09-10336	21-603059	292.5–297.5	6/16/2009	—	—	—	—	—	—	—	440	450	—	—	—	7.1	—	17	—	—	200	—	—	120	—	—	32	18	13	740	—
MD21-09-11275	21-603059	292.5–297.5	7/15/2009	15	—	11	—	—	—	4.2	690	690	—	—	—	11	5.3	26	7	—	320	—	—	200	—	6.1	51	28	23	1200	—
MD21-09-11468	21-603059	292.5–297.5	8/14/2009	51	—	9.1	—	—	9	—	640	630	—	—	—	9.3	4.6	22	—	—	280	—	—	190	—	3.7	52	25	21	1100	—
MD21-09-10337	21-603059	372.5–377.5	6/16/2009	—	—	7.6	—	—	2.6	—	400	520	—	—	—	—	11	35	—	—	610	—	—	67	—	4.6	15	8.8	67	820	—
MD21-09-11276	21-603059	372.5–377.5	7/15/2009	12	—	10	—	—	—	4.6	380	600	—	—	6	—	13	35	—	—	760	—	—	72	—	9.5	14	8.2	85	850	4.6
MD21-09-11467	21-603059	372.5–377.5	8/14/2009	40	3.1	11	—	—	7.2	—	530	700	—	—	7	—	13	48	4.4	—	800	—	—	100	—	6.5	27	11	100	1200	—

Note: Results are in μg/m^3.

* — = Not detected.

Table 5.2-1
Screening of VOCs Detected in Pore Gas at MDA T, June–August 2009

VOC	Maximum Pore Gas Concentration (μg/m^3)	Groundwater SL (μg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (μg/m^3)	SV[a] (unitless)
Acetone	51	22,000[b]	35,200	1.45E-03
Benzene	13	5[c]	1140	1.14E-02
Bromodichloromethane	15	1.2[b]	104.4	1.44E-01
1,3-Butadiene	7.4	0.18[b]	540	1.37E-02
1-Butanol	62(J)	3700[b]	1,332	4.65E-02
2-Butanone	9.6	7100[b]	16,330	5.88E-04
Carbon Disulfide	38	1000[b]	590,000	6.44E-05
Carbon Tetrachloride	830	5[c]	5,500	1.51E-01
Chloroform	1400	100[d]	15,000	9.33E-02
Cyclohexane	6.3	13,000[b]	79,300,000	7.94E-08
1,2-Dichlorobenzene	83	600[c]	46,740	1.78E-03
1,4-Dichlorobenzene	30	75[c]	7,470	4.02E-03
Dichlorodifluoromethane	17	390[b]	5,460,000	3.11E-06
1,2-Dichloroethane	27	5[c]	240	1.13E-01
1,1-Dichloroethene	100	5[d]	5,500	1.82E-02
cis-1,2-Dichloroethane	7	70[c]	11,900	5.88E-04
Hexane	5.6	880[b]	65,120,000	8.60E-08
Methylene chloride	2100	5[c]	650	**3.23E+00**
Tetrachloroethene	3600	5[c]	3,600	1.00E+00
Toluene	200	750[d]	204,000	9.80E-04
1,1,2-Trichloro-1,2,2-trifluoroethane	56	59,000[b]	1,298,000,000	4.31E-08
1,1,1-Trichloroethane	32	60[d]	42,300	7.57E-04
1,1,2-Trichloroethane	200	5[c]	170	**1.18E+00**
Trichloroethene	1500	5[c]	2,000	7.50E-01
1,3-Xylene+1,4-Xylene	4.6	620[d]	167,400	2.75E-05

Notes: Calculated concentrations in pore gas corresponding to groundwater standard derived from denominator of Equation 3.0-3.

[a] SVs greater than 1 are shown in bold.

[b] EPA regional tapwater screening levels (http://www.epa.gov/region06/6pd/rcra_c/pd-n/screen.htm).

[c] EPA MCL (40 Code of Federal Regulations 141.61).

[d] NMWQCC groundwater standard (20.6.2.3103 New Mexico Administrative Code).

Table 5.2-2
Screening of Methylene Chloride and 1,1,2-Trichloroethane Concentrations in the Deepest Port in Vapor-Monitoring Well 21-25262, June–August 2009

VOC	Maximum Pore-Gas Concentration at TD (µg/m^3)	Groundwater SL* (µg/L)	Calculated Concentrations in Pore Gas Corresponding to Groundwater Standard (µg/m^3)	SV (unitless)
Methylene chloride	260	5	650	4.00E-01
1,1,2-Trichloroethane	37	5	170	2.18E-01

Note: Calculated concentrations in pore gas corresponding to groundwater standard derived from denominator of Equation 3.0-3.
*EPA MCL (40 Code of Federal Regulations 141.61).

Table 5.3-1
Summary of Tritium Results in Pore-Gas Samples at MDA T, June–August 2009

Sample ID	Location/Well ID	Depth (ft)	Collection Date	Tritium (pCi/L)
MD21-09-10355	21-25262	80–85	6/12/2009	—*
MD21-09-11294	21-25262	80–85	7/14/2009	1041.7
MD21-09-11488	21-25262	80–85	8/11/2009	1129.8
MD21-09-10356	21-25262	115–120	6/12/2009	—
MD21-09-11295	21-25262	115–120	7/14/2009	441.1
MD21-09-11489	21-25262	115–120	8/11/2009	516.15
MD21-09-10357	21-25262	232–237	6/12/2009	19571
MD21-09-11296	21-25262	232–237	7/14/2009	556.99
MD21-09-11490	21-25262	232–237	8/11/2009	930.32
MD21-09-10358	21-25262	295–300	6/12/2009	901.05
MD21-09-11297	21-25262	295–300	7/14/2009	3199.5
MD21-09-11491	21-25262	295–300	8/13/2009	3885.8
MD21-09-10359	21-25262	329.5–334.5	6/12/2009	3062.3
MD21-09-11298	21-25262	329.5–334.5	7/14/2009	6803.9
MD21-09-11492	21-25262	329.5–334.5	8/13/2009	5167.2
MD21-09-10360	21-25262	375–380	6/12/2009	13958
MD21-09-11299	21-25262	375–380	7/14/2009	37413
MD21-09-11493	21-25262	375–380	8/11/2009	40119
MD21-09-10361	21-25262	472.25–478	6/12/2009	—
MD21-09-11300	21-25262	472.25–478	7/14/2009	—
MD21-09-11494	21-25262	472.25–478	8/13/2009	1401.2
MD21-09-10362	21-25262	572–577	6/12/2009	—
MD21-09-11301	21-25262	572–577	7/14/2009	321.43
MD21-09-11495	21-25262	572–577	8/14/2009	33964
MD21-09-10363	21-25262	686–691	6/15/2009	—
MD21-09-11302	21-25262	686–691	7/14/2009	420.84
MD21-09-11496	21-25262	686–691	8/14/2009	721.54
MD21-09-10344	21-25264	67.5–72.5	6/17/2009	142818

Table 5.3-1 (continued)

Sample ID	Location/Well ID	Depth (ft)	Collection Date	Tritium (pCi/L)
MD21-09-11283	21-25264	67.5–72.5	7/17/2009	10560
MD21-09-11477	21-25264	67.5–72.5	8/19/2009	12.32
MD21-09-10345	21-25264	150.5–155.5	6/17/2009	133254
MD21-09-11284	21-25264	150.5–155.5	7/17/2009	173113
MD21-09-11478	21-25264	150.5–155.5	8/19/2009	198.29
MD21-09-10346	21-25264	222.5–227.5	6/17/2009	2093.3
MD21-09-11285	21-25264	222.5–227.5	7/17/2009	123530
MD21-09-11479	21-25264	222.5–227.5	8/19/2009	143.56
MD21-09-10347	21-25264	323–328	6/17/2009	3952.9
MD21-09-11286	21-25264	323–328	7/17/2009	2323.9
MD21-09-11480	21-25264	323–328	8/19/2009	2.9595
MD21-09-10348	21-25264	349.5–354.5	6/17/2009	2873.7
MD21-09-11287	21-25264	349.5–354.5	7/17/2009	7802.8
MD21-09-11481	21-25264	349.5–354.5	8/19/2009	3.106
MD21-09-10339	21-603058	67.5–72.5	6/18/2009	545.97
MD21-09-11278	21-603058	67.5–72.5	7/16/2009	—
MD21-09-11472	21-603058	67.5–72.5	8/18/2009	258.45
MD21-09-10341	21-603058	217–222	6/18/2009	2627.8
MD21-09-11280	21-603058	217–222	7/16/2009	980.78
MD21-09-11473	21-603058	217–222	8/18/2009	991.64
MD21-09-10342	21-603058	242.5–247.5	6/18/2009	3203.4
MD21-09-11281	21-603058	242.5–247.5	7/16/2009	3253.2
MD21-09-11474	21-603058	242.5–247.5	8/18/2009	2949.1
MD21-09-10343	21-603058	339.5–344.5	6/18/2009	530.52
MD21-09-11282	21-603058	339.5–344.5	7/16/2009	—
MD21-09-11475	21-603058	339.5–344.5	8/18/2009	—
MD21-09-10333	21-603059	77.5–82.5	6/16/2009	334.83
MD21-09-11272	21-603059	77.5–82.5	7/15/2009	—
MD21-09-11469	21-603059	77.5–82.5	8/14/2009	501.31
MD21-09-10334	21-603059	187.5–192.5	6/16/2009	628.59
MD21-09-11273	21-603059	187.5–192.5	7/15/2009	601.61
MD21-09-11470	21-603059	187.5–192.5	8/14/2009	538.61
MD21-09-10335	21-603059	229.5–234.5	6/16/2009	1660.8
MD21-09-11274	21-603059	229.5–234.5	7/15/2009	1428.5
MD21-09-11471	21-603059	229.5–234.5	8/14/2009	1529.3
MD21-09-10336	21-603059	292.5–297.5	6/16/2009	4605.5
MD21-09-11275	21-603059	292.5–297.5	7/15/2009	4776.4
MD21-09-11468	21-603059	292.5–297.5	8/14/2009	6175.6
MD21-09-10337	21-603059	372.5–377.5	6/16/2009	6449.8
MD21-09-11276	21-603059	372.5–377.5	7/15/2009	6527.3
MD21-09-11467	21-603059	372.5–377.5	8/14/2009	6520

* — = Not detected.

Appendix A

Acronyms and Abbreviations,
Metric Conversion Table, and Data Qualifier Definitions

A-1.0 ACRONYMS AND ABBREVIATIONS

%R	percent recovery
%RSD	percent relative standard deviation
bgs	below ground surface
CCV	continuing calibration verification
COC	chain of custody
DER	duplicate error ratio
EPA	Environmental Protection Agency (U.S.)
FB	field blank
FD	field duplicate
ICV	initial calibration verification
LAL	lower acceptance limit
LANL	Los Alamos National Laboratory
LCS	laboratory control sample
MCL	maximum contaminant level
MDA	material disposal area
MDC	minimum detectable concentration
NMED	New Mexico Environment Department
NMWQCC	New Mexico Water Quality Control Commission
MS	matrix spike
PB	performance blank
PCE	tetrachloroethene
QA	quality assurance
QC	quality control
SCL	sample collection log
SL	screening level
SMO	Sample Management Office
SOP	standard operating procedures
SOW	statement of work
SQL	standard quantitation limit
SV	screening value
TA	technical area
TCE	trichloroethene
TD	total depth

VOC	volatile organic compound

A-2.0 METRIC CONVERSION TABLE

Multiply SI (Metric) Unit	by	To Obtain U.S. Customary Unit
kilometers (km)	0.622	miles (mi)
kilometers (km)	3281	feet (ft)
meters (m)	3.281	feet (ft)
meters (m)	39.37	inches (in.)
centimeters (cm)	0.03281	feet (ft)
centimeters (cm)	0.394	inches (in.)
millimeters (mm)	0.0394	inches (in.)
micrometers or microns (µm)	0.0000394	inches (in.)
square kilometers (km^2)	0.3861	square miles (mi^2)
hectares (ha)	2.5	acres
square meters (m^2)	10.764	square feet (ft^2)
cubic meters (m^3)	35.31	cubic feet (ft^3)
kilograms (kg)	2.2046	pounds (lb)
grams (g)	0.0353	ounces (oz)
grams per cubic centimeter (g/cm^3)	62.422	pounds per cubic foot (lb/ft^3)
milligrams per kilogram (mg/kg)	1	parts per million (ppm)
micrograms per gram (µg/g)	1	parts per million (ppm)
liters (L)	0.26	gallons (gal.)
milligrams per liter (mg/L)	1	parts per million (ppm)
degrees Celsius (°C)	9/5 + 32	degrees Fahrenheit (°F)

A-3.0 DATA QUALIFIER DEFINITIONS

Data Qualifier	Definition
U	The analyte was analyzed for but not detected.
J	The analyte was positively identified, and the associated numerical value is estimated to be more uncertain than would normally be expected for that analysis.
J+	The analyte was positively identified, and the result is likely to be biased high.
J-	The analyte was positively identified, and the result is likely to be biased low.
UJ	The analyte was not positively identified in the sample, and the associated value is an estimate of the sample-specific detection or quantitation limit.
R	The data are rejected as a result of major problems with quality assurance/quality control parameters.

Appendix B

Field Methods

B-1.0 INTRODUCTION

This appendix summarizes the field methods used during the June–August 2009 sampling activities at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory). All activities were conducted in accordance with the applicable standard operating procedures (SOPs), quality procedures, Laboratory implementation requirements, and Laboratory procedural requirements. Table B-1.0-1 provides a summary of the field methods used, and Table B-1.0-2 lists the applicable procedures.

B-2.0 FIELD METHODS

All work was conducted per a site-specific health and safety plan and an integrated work document. Field activities conducted according to SOPs are discussed below.

B-2.1 Volatile Organic Compound Pore-Gas Field-Screening and Sample Collection

All volatile organic compound (VOC) samples are collected in accordance with the current version of the EP-ERSS-SOP-5074, Sampling for Sub-Atmospheric Air.

Before each sampling event, each sample port is purged and monitored with a Landtec GEM2000 instrument (or equivalent) until the percent carbon dioxide and oxygen levels stabilize at values representative of subsurface pore-gas conditions. In addition, the vapor-sample tubing is purged of stagnant air by drawing air from the sampling interval through the line. To ensure the sample collected is representative of the subsurface air at depth, every sampling activity includes a purge cycle. Once purging and field screening are complete, vapor samples for VOC analysis are collected using SUMMA canisters and the sample information is recorded on the appropriate sample collection log (SCL). Field-screening results are also recorded on the appropriate SCL and/or in the field logbook. Field chains of custody and SCLs are provided in Appendix D.

In addition to the characterization samples, two types of quality assurance/quality control (QA/QC) samples are collected and analyzed for VOCs using SUMMA canisters; field duplicate (FD) samples and field blanks (FB) of ultra-pure nitrogen. The FD and FB samples are collected at a frequency greater than or equal to 10% per sampling event in accordance with the current version of EP-ERSS-SOP-5059, Field Quality Control Samples. A summary of all June–August 2009 analytical and QA/QC samples collected from vapor-monitoring wells 21-603058, 21-603059, 21-25264, 21-25262, and their requested analyses is presented in Table 2.0-2 of the report.

All samples are submitted to the Sample Management Office (SMO) for processing and transport to off-site contract analytical laboratories.

B-2.2 Tritium Pore-Gas Sample Collection

All tritium samples are collected in accordance with the current version of EP-ERSS-SOP-5074. Water vapor intended for tritium analysis is collected from pore gas by pulling a pore-gas sample through a canister of silica gel and the sample information recorded on the appropriate SCL (Appendix D). Silica gel column FD samples are also collected at a frequency greater than or equal to 10% per sampling event in accordance with the current version of EP-ERSS-SOP-5059.

Following delivery of the canister and silica gel sample to the analytical laboratory, the silica gel is heated and the moisture driven off is collected for liquid scintillation counting. Dry silica gel contains bound water, which dilutes the tritium sample. A correction factor for this dilution is developed for each sample, based on the percent moisture value determined by the analytical laboratory (Marczak 2009, 106500; Whicker et al. 2009, 106429).

Silica gel is prepared for sampling by drying it at a temperature above 100°C; however, this drying process does not remove bound water. Before sample collection, the amount of silica gel used in each sample is weighed (typically about 135 g) as well as the sample canister with silica gel. EP-ERSS-SOP-5074 requires that at least 5 g of moisture be collected. After sampling, sample canister with silica gel is weighed again.

The sample (canister plus silica gel) is shipped to the analytical laboratory where the canister with silica gel is weighed again. The silica gel is emptied into a distillation apparatus and heated to 110°C, driving moisture off the silica gel. This moisture is collected and analyzed for tritium by liquid scintillation. The laboratory also weighs the empty canister and calculates the percent moisture of the sample, as the amount of moisture collected divided by the calculated weight of the wet silica gel. The value of the tritium concentration and the calculated percent moisture are reported to the Laboratory in the analytical data package and the electronic data deliverable.

The correction factor for the impact of bound water is determined for each sample. The correction factors for the June and July tritium concentration data presented in this report are determined from the percent moisture values provided by the analytical laboratory (Marczak 2009, 106500). The ER-ERSS-SOP-5074 was updated in July 2009 to ensure collection of silica gel field weights. The August 2009 tritium concentration data presented in this report are determined from the silica gel field weights.

B-3.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.

Marczak, S., July 2009. "Technical Implementation of the Correction Factor Calculation for Tritium in Pore-Gas Data," Los Alamos National Laboratory document LA-UR-09-4629, Los Alamos, New Mexico. (Marczak 2009, 106500)

Whicker, J.J., J.M. Dewart, S.P. Allen, W.F. Eisele, M.C. McNaughton, and A.A. Green, June 17, 2009. "Corrections for Measurement of Tritium in Subterranean Vapor Using Silica Gel," Los Alamos National Laboratory document LA-UR-09-03837, Los Alamos, New Mexico. (Whicker et al. 2009, 106429)

Table B-1.0-1
Summary of Field Methods

Method	Summary
General Instructions for Field Investigations	This procedure provides an overview of instructions regarding activities to be performed before, during, and after field investigations. It is assumed field investigations involve standard sampling equipment, personal protective equipment, waste management, and site-control equipment/materials. The procedure covers premobilization activities, mobilization to the site, documentation and sample collection activities, sample media evaluation, surveillance, and completion of lessons learned.
Sample Containers and Preservation	Specific requirements/processes for sample containers, preservation techniques, and holding times are based on the U.S. Environmental Protection Agency guidance for environmental sampling, preservation, and QA. Specific requirements are met for each sample and are printed in the sample collection logs provided by the Laboratory's SMO (size and type of container, preservatives, etc.). All samples are preserved by placing them in insulated containers with ice to maintain a temperature of 4°C.
Handling, Packaging, and Transporting Field Samples	Field team members seal and label samples before packing to ensure sample and transport containers are free of external contamination. All environmental samples are collected, preserved, packaged, and transported to the SMO under chain of custody (COC). The SMO arranges for shipping of the samples to analytical laboratories. Any levels of radioactivity (i.e., action-level or limited-quantity ranges) are documented in SCLs submitted to the SMO.
Sample Control and Field Documentation	The collection, screening, and transport of samples are documented in standard forms generated by the SMO. These forms include SCLs, COC forms, sample container labels, and custody seals. Collection logs are completed at the time of sample collection and are signed by the sampler and a reviewer who verifies the logs for completeness and accuracy. Corresponding labels are initialed and applied to each sample container, and custody seals are placed around container lids or openings. COC forms are completed and signed to verify that the samples are not left unattended.
Field QC Samples	Field QC samples are collected as follows: FDs are collected at a frequency of 10% at the same time as a regular sample and submitted for the same analyses. FBs are required for all field events that include collecting samples for VOC analyses, are collected. Field blanks are kept with the other sample containers during the sampling process and are submitted for laboratory analyses.
Sampling of Sub-Atmospheric Air	Vapor sampling was performed on three monitoring wells in accordance with the current version of EP-ERSS-SOP-5074 and analyzed for VOCs and tritium. This SOP describes the process of sampling subatmospheric air from vapor ports in monitoring wells and boreholes. The procedure covers presampling activities, sampling to detect and quantify gaseous organic concentration in air, SUMMA sampling (a passive collection and containment system of laboratory-quality air samples), adsorbent column sampling, and sampling through the packer system (a sampling system that uses inflatable bladders to seal off a desired interval in an open borehole or at the end of drill casing to obtain a sample from a discrete section), and postsampling activities.

Table B-1.0-2
List of Applicable General Procedures for MDA T Pore-Gas Monitoring Activities

Document Number	LANL Procedure Title
EP-ERSS-SOP-5055	General Instructions for Field Investigations
EP-ERSS-SOP-5056	Sample Containers and Preservation
EP-ERSS-SOP-5057	Handling, Packaging, and Transporting Field Samples
EP-ERSS-SOP-5058	Sample Control and Field Documentation
EP-ERSS-SOP-5059	Field Quality Control Samples
EP-ERSS-SOP-5061	Field Decontamination of Equipment
EP-ERSS-SOP-5074	Sampling for Sub-Atmospheric Air
P 101-6	Personal Protective Equipment
SOP-01.12	Field Site Closeout Checklist
SOP-01.13,	Initiating and Managing Data Set Requests
SOP-5181	Notebook Documentation for Environmental Restoration Technical Activities
SOP-5228	ADEP Reporting Requirements for Abnormal Events

Appendix C

Quality Assurance/Quality Control Program

C-1.0 INTRODUCTION

This appendix presents the analytical methods and summarizes the data quality review for the June, July, and August 2009 pore gas samples collected at Material Disposal Area (MDA) T, Consolidated Unit 21-016(a)-99, in Technical Area 21 at Los Alamos National Laboratory (LANL or the Laboratory).

Quality assurance (QA), quality control (QC), and data validation procedures were implemented in accordance with the "Quality Assurance Project Plan Requirements for Sampling and Analysis" (LANL 1996, 054609), and the Laboratory's statement of work (SOW) for analytical services (LANL 2000, 071233). The results of the QA/QC activities were used to estimate the accuracy, bias, and precision of the analytical measurements. QC samples, including method blanks, matrix spikes (MSs), laboratory control samples (LCSs), internal standards, initial calibration verifications (ICVs) and continuing calibration verifications (CCVs), surrogates, and tracers, were used to assess analytical laboratory accuracy and bias.

The type and frequency of QC analyses are described in the analytical services SOW (LANL 2000, 071233). Other QC factors such as sample preservation and holding times were also assessed. The requirements for sample preservation and holding times are presented in the standard operating procedure (SOP) EP-ERSS-SOP-5056, Sample Containers and Preservation. Evaluating these QC indicators allows estimates to be made of the accuracy, bias, and precision of the analytical suites. A focused data validation was also performed for all the data packages (identified by request number) that included a more detailed review of the raw data results. The SOPs used for data validation are presented in Table C-1.0-1. Copies of the analytical data, laboratory logbooks, and instrument printouts are provided in Appendix D (on CD).

A systematic low bias in previously reported tritium pore-vapor measurements was identified (Whicker et al. 2009, 106429), and all tritium data presented in this report are corrected for this bias (Marczak 2009, 106500). The June and July 2009 tritium results were corrected using the percent moisture value determined by the analytical laboratory. The August 2009 tritium results were corrected using silica gel field weights. Details are discussed in section C-4.0.

Analytical data were reviewed and evaluated based on U.S. Environmental Protection Agency (EPA) National Functional Guidelines for organic chemical data review, where applicable (EPA 1994, 048639; EPA 1999, 066649). Data have also been assessed using guidelines established in SW-846 (EPA 1997, 057589). As a result of the data validation and assessment efforts, qualifiers have been assigned to the appropriate analytical records. Definitions of the data qualifiers are presented in Appendix A.

C-2.0 ANALYTICAL DATA ORGANIZATION AND VINTAGE

The June–August 2009 pore-gas analytical data are obtained from 90 samples (69 characterization and 21 QA/QC) collected during three sampling events (June, July, and August 2009) from vapor-monitoring well locations 21-25262, 21-25264, 21-603058, and 21-603059. Complete data packages and sample documentation for the 2009 samples are provided in Appendix D (on CD).

C-3.0 ORGANIC CHEMICAL ANALYSIS METHODS

Pore-gas samples were submitted for analysis of volatile organic compounds (VOCs) using EPA Method TO-15 (Table C-3.0-1). Table 2.0-2 of the periodic monitoring report summarizes all June–

August 2009 pore-gas samples collected to during June–August 2009 at MDA T and the requested analyses. All VOC results are provided on CD in Appendix D.

C-3.1 Organic Chemical QA/QC Samples

The QC samples are designed to produce a qualitative measure of the reliability of a specific part of an analytical procedure. The methods for validating organic chemical results on the basis of the various QA/QC sample types are specified in the SOPs. The validation of organic chemical data using QA/QC samples and other methods may have resulted in the rejection of the data or the assignment of various qualifiers to individual sample results.

Calibration verifications, LCSs, method blanks, surrogates, and internal standards were analyzed to assess the accuracy and precision of organic chemical analyses. Each of these QA/QC sample types is defined in the analytical services SOW (LANL 2000, 071233), described in the applicable validation SOPs, and summarized below.

Calibration verification is the establishment of a quantitative relationship between the response of the analytical instrument and the concentration of the target analyte. There are two aspects of calibration verification: initial and continuing. The initial calibration verifies the linearity of the calibration curve as well as the individual calibration standards used to perform the calibration. The continuing calibration verifies the initial calibration is still linear and valid. The continuing calibration also serves to determine that analyte identification criteria, such as retention times and spectral matching, are being met.

The LCS is a sample of the same matrix spiked with the target analytes and serves to monitor the overall performance. Following Laboratory SOP guidance, analytical results were qualified if the individual LCS recoveries were not within method-specific acceptance criteria.

A method blank is an analyte-free matrix to which reagents are added in the same volumes or proportions as those used in the environmental sample processing and is extracted and analyzed in the same manner as the corresponding environmental samples. Method blanks are used to assess the potential for sample contamination during extraction and analysis.

A surrogate compound (surrogate) is an organic chemical used in the analyses of target analytes. The surrogate is similar in composition and behavior to the target analytes but is not normally found in environmental samples. Surrogates are added to every blank, sample, and spike to evaluate the efficiency with which analytes are recovered during extraction and analysis. The recovery percentage of the surrogates must be within specified ranges, or the sample may be rejected or assigned a qualifier.

Internal standards are chemical compounds added to every blank, sample, and standard extract at a known concentration. Internal standards are used as the basis for quantitation of target analytes. The percent recovery (%R) for internal standards should be within the range of 50% to 200%.

The data quality of the June–August 2009 MDA T VOC pore-gas data is summarized below.

C-3.1.1 MDA T Pore-Gas VOC Data

During the June–August 2009 monitoring period, 69 characterization samples and 21 QA/QC samples were collected and submitted for VOC analysis.

No VOC data were rejected.

One 1,4-dichlorobenzene result and one 2-propanol result were qualified as estimated (J) because the analytical laboratory qualified the result as estimated and requalification of the data via data validation did not occur.

Two 1-butanol results were qualified as estimated (J) because the ICV exceeded the percent relative standard deviation (%RSD) criteria and/or the associated multipoint calibration correlation coefficient is <0.995.

A total of 243 VOC results (183 characterization and 60 QA/QC) were qualified as estimated and not detected (UJ) either because

- the ICV exceeded the %RSD criteria and/or the associated multipoint calibration correlation coefficient is <0.995 (30 benzyl chloride results; 58 1-butanol results; 30 hexachlorobutadiene results; 27 methanol results; and 30 4-methyl-2-pentanone results);
- the ICV and/or CCV were recovered outside the method-specific limits (27 ethanol results; 8 methanol results; and 8 1,2,4-trichlorobenzene results); or
- the LCS percent recovery (%R) was less than the lower acceptance limit (LAL) but greater than 10% (3 ethanol results; 22 1,2,4-trichlorobenzene results).

C-4.0 RADIONUCLIDE ANALYSIS METHODS

The vapor samples collected in June–August 2009 were analyzed by EPA Method 906.0 for tritium (Table C-3.0-1). Table 2.0-2 of the monitoring report summarizes all June–August 2009 vapor samples collected at MDA T and the requested analyses. All tritium results are provided on CD in Appendix D.

During a technical review of EP-ERSS-SOP-5074, Sampling Sub-Atmospheric Air, the Laboratory determined that analytical results were not being corrected for water bound in silica gel used to collect vapor samples, thereby identifying a systematic low bias in previously reported tritium results (Whicker et al. 2009, 106429). The bias results from the properties of silica gel, the sample medium used to collect water vapor from pore-gas samples. Silica gel contains nontritiated water vapor bound to the silica gel molecules that cannot be completely removed by drying before it is used in sampling without degrading the silica gel properties. Thus, when water vapor is collected from the pore gas, the tritiated sample water vapor is mixed/diluted into the clean water bound to the silica gel molecules. The amount of dilution is proportional to the amount of silica gel–bound water in the original sample and the amount of moisture collected in the sample. The June and July 2009 tritium results were corrected using the percent moisture values determined by the analytical laboratory (Marczak 2009, 106500). The August 2009 tritium results were corrected using silica gel field weights (Marczak 2009, 106500). The corrected tritium results are reported in Table 5.3-1of the monitoring report and in Appendix D.

C-4.1 Radionuclide QA/QC Samples

The minimum detectable concentration (MDC) for tritium in performance blanks (PBs), method blanks, laboratory duplicates, tracer/carrier recovery, LCSs, and MS samples were analyzed to assess the accuracy and precision of the radionuclide analysis. The qualifiers and sample types for radionuclides are defined in the analytical services SOW (LANL 1995, 049738; LANL 2000, 071233), described in the applicable validation SOPs, and discussed briefly below. The validation of radionuclide data using QA/QC samples and other methods may have resulted in the rejection of data or the assignment of various qualifiers to individual sample results.

The MDC for each radionuclide is defined as the minimum activity concentration the analytical laboratory equipment can detect in 95% of the analyzed samples and is used to assess analytical performance.

Uncertainty and MDC results for tritium have been modified in the same manner as the analytical results to account for the bound water found in silica gel used for sample collection.

The PBs and method blanks are used to measure bias and assess potential cross-contamination of samples during preparation and analysis. Blank results should be less than the MDC for each radionuclide.

Laboratory duplicates are used to assess or demonstrate acceptable laboratory method precision at the time of analysis as well as to assess the long-term precision of an analytical method on various matrices. Duplicate results are used to calculate a duplicate error ratio (DER). The DER is based on 1 standard deviation of the sample and the duplicate sample and should be less than 4.

The LCS serves as a monitor of the overall performance of each step during the analysis, and the acceptance criteria for LCSs are method-specific. For radionuclide methods, LCS %Rs should fall within the control limits of 80% to 120%.

The accuracy of radionuclide analyses is also assessed using MS samples. These samples are designed to provide information about the effect of the sample matrix on the sample preparation procedures and analytical technique. The MS %Rs should be within the acceptance range of 75% to 125%; however, if the sampling result is more than 4 times the amount of the spike added, these acceptance criteria do not apply.

The data quality of the June–August 2009 MDA T tritium data is summarized below.

C-4.1.1 MDA T Pore-Gas Tritium Data

During the June–August 2009 monitoring period, 69 characterization samples and 12 QA/QC samples were collected and submitted for tritium analysis.

No tritium data were rejected and no data quality issues were identified.

All tritium data collected in June–August 2009 from MDA T pore gas were used to evaluate tritium trends over the monitoring period. Validated analytical results have been corrected for bound-water dilution under reporting.

C-5.0 REFERENCES

The following list includes all documents cited in this appendix. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.

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EPA (U.S. Environmental Protection Agency), February 1994. “USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,” EPA-540/R-94/013, Office of Emergency and Remedial Response, Washington, D.C. (EPA 1994, 048639)

EPA (U.S. Environmental Protection Agency), 1997. “Test Methods for Evaluating Solid Waste, Laboratory Manual, Physical/Chemical Methods,” SW-846, 3rd ed., Update III, Office of Solid Waste and Emergency Response, Washington, D.C. (EPA 1997, 057589)

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LANL (Los Alamos National Laboratory), July 1995. “Statement of Work (Formerly Called "Requirements Document") - Analytical Support, (RFP number 9-XS1-Q4257), (Revision 2 - July, 1995),” Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 1995, 049738)

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LANL (Los Alamos National Laboratory), December 2000. “University of California, Los Alamos National Laboratory (LANL), I8980SOW0-8S, Statement of Work for Analytical Laboratories,” Rev. 1, Los Alamos National Laboratory, Los Alamos, New Mexico. (LANL 2000, 071233)

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Table C-1.0-1
Data Validation Procedures

Procedure	Title	Effective Date
SOP-5161, Rev. 0	Routine Validation of Volatile Organic Compound (VOC) Analytical Data	6/10/2008
SOP-5166, Rev. 0	Routine Validation of Gamma Spectroscopy, Chemical Separation Alpha Spectrometry, Gas Proportional Counting, and Liquid Scintillation Analytical Data	6/30/2008

Table C-3.0-1
Analytical Methods for MDA T Pore-Gas Samples

Analytical Method	Analytical Description	Analytical Suite
EPA Method TO-15	Gas Chromatography/Mass Spectrometry	VOC
EPA Method 906	Liquid Scintillation	Tritium

Appendix D

Analytical Suites and Results and Analytical Reports
(on CD included with this document)