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Summary Report: 2006 In Situ Soil Vapor Extraction Pilot Study at Material Disposal Area L, Technical Area 54, Los Alamos National Laboratory

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1.0 INTRODUCTION

This document presents the results of an in situ soil vapor extraction (SVE) pilot study at Material Disposal Area (MDA) L in Technical Area (TA) 54. The pilot test was conducted to evaluate the efficacy of SVE as a method to remove organic vapor from the subsurface and to minimize the growth of the subsurface volatile organic compounds (VOCs) plume in the event that the source term changes substantially (e.g., one or more of the containers holding the liquid waste fails). The results of the pilot study will be used to support the MDA L corrective measures evaluation (CME) by documenting the data collected on the performance of SVE technology.

Previous SVE investigations conducted at MDA L include a pilot extraction study plan (PESP), and independent Technical Advisory Group (TAG) study to evaluate possible alternatives for remediating the plume. Included in the PESP was a pilot vapor extraction test (PVET), in which a SVE system was operated in 1994 and 1995 near the outer boundary of the plume (SEA 2005, 87918). The results of this test demonstrated the potential effectiveness of SVE at MDA L. Based on a data review, including the results of the PVET, the TAG concluded that SVE would be an effective method for removing VOCs at the site (LANL 2005, 87624).

Data from the pilot test will be used to evaluate the potential of SVE for remediating the current MDA L vapor plume and for controlling future releases from two vertical shaft source areas. Los Alamos National Laboratory (LANL or the Laboratory) will use these data to simulate the movement of VOCs in the subsurface using the computer code Finite Element Heat and Mass (Zyvoloski et al.1997, 70147), to simulate the venting tests, to develop extraction rates over time, to estimate the zone of influences for remediating the plume, and to evaluate the effectiveness of SVE method. If SVE is selected as part of the final remedy for the site, then design criteria will be developed in the corrective measure implementation report.

2.0 BACKGROUND

2.1 Site History

MDA L, an approximately 2.5 acre site, was used for subsurface disposal of Laboratory-generated nonradiological liquid chemical waste. From the early 1960s to 1985, both containerized and uncontainerized liquid chemical wastes, including chlorinated solvents, were disposed of at the site. Three surface impoundments, 1 pit, and 34 vertical shafts comprised the MDA L disposal facilities, as shown in Figure 2.1.1 None of the disposal units were lined.

The 34 disposal shafts are split into two areas on either end of MDA L. Shafts 1–28 operated from 1975 to 1985 and are grouped on the east end of MDA L around Pit A; Shafts 29–34 operated from 1983 to 1985 and are grouped on the west end of MDA L. The majority of the shafts are 60 ft deep and range from 3 ft to 8 ft in diameter. The shafts primarily received 55-gal. metal drums containing chemical liquid waste (LANL 1993, 22430). The drums were layered with one-to-six barrels per layer. Each layer was covered with approximately 6 in. of crushed tuff to provide absorbent material for any leaks as well as structural support for the drums. Before 1982, containerized liquids were disposed of without adding absorbents to the containers in which they were placed. In addition to the drums, unknown quantities of small containers and free products were disposed of in the shafts. The shafts are considered to be the contaminant sources for the VOC plume. No existing records provide the estimated waste volumes in the shafts.

Figure 2.1-1. Locations of subsurface disposal units and utilities at MDA L in TA-54

Characterization of the site began in 1985. Since 1997, the Laboratory has conducted quarterly sampling of VOC pore gas throughout the subsurface area to monitor the VOC plume. The monitoring and completion of activities identified in the MDA L investigation work plan (LANL 2004, 87624) have provided sufficient data to determine the nature and extent of the plume. Extraction data from a previous SVE pilot study, carried out between 1994 and 1995, showed that the contaminant movement through the media was not retarded. This finding, coupled with the fact that rock samples from boreholes as deep as 300 ft showed no condensed liquid VOC or sorption of organic chemicals on the matrix, indicates that no free liquid form of VOCs are present. This observation is consistent with expectation based on the absence of organic carbon, low moisture content, and low specific surface area of the media and is supported by equilibrium-partitioning calculations using data from tuff samples and collocated vapor samples. Based on observations from both long-term monitoring and modeling, the conceptual model of the site assumes that organic liquids leak slowly from the buried containers and volatilize rapidly into the tuff pore space and that the VOC vapor-phase plume is at near-steady state.

After subsurface disposal activities at the site ended, the surface was covered with asphalt. Area L is currently used for Resource Conservation and Recovery Act (RCRA)-permitted hazardous waste storage and treatment and for storage of mixed-waste under interim status.

2.2 Site Description and Geologic Setting

The Laboratory lies on the Pajarito Plateau between the Jemez Mountains and the Rio Grande. Bandelier Tuff, a thick sequence of ash-fall pyroclastics, caps the plateau. Erosion of the tuff over time has created a series of canyons separating the narrow, finger-like mesas that comprise Pajarito Plateau. MDA L is situated atop one such mesa, Mesita del Buey.

The strata below MDA L are composed of nonwelded to moderately welded rhyolitic ash-flow and ash-fall tuffs interbedded within pumice beds. The rhyolitic units overlie a thick basalt unit, which, in turn, overlies a conglomerate formation. Canyons on either side of MDA L (Cañada del Buey to the north and Pajarito Canyon to the south) lie approximately 100 ft below the steep-sided mesa. The regional aquifer is located approximately 985 ft below the disposal pits; no perched aquifers are known to occur below the mesa (LANL 1998, 59599). Perched water was not encountered in a borehole drilled to a depth of 660 ft (LANL 2005, 90512).

The Bandelier Tuff is the uppermost formation and consists of the Tshirege and Otowi Members, separated by the Cerro Toledo interval (Qct). Three upper units make up the Tshirege Member of the Bandelier Tuff. Unit 2 (Qbt 2) and the upper portion of unit 1v (Qbt 1v) are fractured, and the fractures are often filled with calcite and/or clay. The Cerro Toledo interval is made up of volcanoclastic sediments interbedded with minor pyroclastic flows. The Otowi Member (Qbo) underlies the Cerro Toledo interval and is made up of nonwelded to poorly welded tuff containing little evidence of fracturing (Vaniman and Chipera 1993, 58032).

The Cerros del Rio basalts lie beneath the tuffs and make up roughly 35% of the vadose zone. Characteristics of this unit vary widely, ranging from extremely dense with no effective porosity to highly fractured to very vesicular so as to appear foamy (Turin 1995, 70225). The Puye Formation underlies the Cerros del Rio basalts and extends from the base of the vadose zone well into the saturated zone. A complete summary of the site geology and geologic properties can be found in the MDA L investigation work plan (LANL 2005, 87624).

2.2.1 The Vapor Plume

Pore-gas analytical results from quarterly sampling continue to indicate that the highest concentrations of vapor-phase VOCs exist in close proximity to the two shaft clusters (at the east and west ends of MDA L). Trichloroethane (TCA) has consistently been the most prevalent VOC detected in pore-gas samples and is the best indicator of the extent of the plume.

Since 1999, the long-axis areal extent of the plume, defined by the 10 parts per million by volume (ppmv) contour of TCA, has fluctuated between 700 and 1000 ft. The short-axis extent has not fluctuated significantly because of the physical constraint of the mesa walls (zero-concentration boundaries). Vertically, the maximum extent of the 10 ppmv TCA contour is approximately 300 ft below the mesa top (pore-gas samples are monitored to a depth of 607 ft bgs). The extent has not fluctuated significantly since 1999 (LANL 2005, 87624). The 10 ppmv TCA contour is approximately 650 ft above the regional aquifer. Data analysis of pore-gas pressures and chemical constituents at boreholes 54-01015 and 54-01016 during 1995 and 1996 indicate that the Cerros del Rio basalt layer is connected to the atmosphere at a remote, unknown location. The plume decreases to field-screening detection-limit concentrations before the basalt contact; thus, any contaminant entering the basalt layer is at or below field-screening detection levels. A pore-gas sample collected from the basalt during 2005 contained approximately 40 parts per billion by volume (ppbv) of TCA.

The plume is in a near-steady-state condition. Stauffer et al. (2002, 69794) modeled the plume evolution using a three-dimensional finite element program. The model assumed vapor diffusion emanating from two source areas located at the two shaft fields at MDA L. The model was calibrated using the quarterly pore-gas monitoring data. The resulting modeled plume closely matches the shape, concentration gradients and the extent of the plume as measured during periodic pore-gas monitoring. The model also predicted that the plume should be at or near steady state. This modeling supported the conclusion that the VOC plume exists predominantly in the vapor phase, that the VOCs move by diffusion, and that the plume is stable. Stauffer et al. (2002, 69794) also predicted the plume's evolution over time, concluding that if the assumed source remains constant, the plume will continue to grow slowly. The model fit was improved by allowing for the partitioning of VOC into pore water. If a constant source was removed in the simulations, the plume decreased in mass as VOC was lost to the atmospheric boundary, with the 10 ppmv contour contracting back toward the source region.

Given the relatively constant state of the plume, it can be deduced that the mass of contaminant added to the source by small leaks from the containers must be balanced by the atmospheric emissions through the mesa sides, basalt layer, and atmospheric boundary. However, wastes in the 34 disposal shafts represent a significant uncertainty for any future predictions because the magnitude of future contaminant release rates cannot be predicted. The number of intact drums, bottles, or other containers is not known, and it is not possible to predict when or if they will fail. The Laboratory recognizes the need to consider future drum failures in managing the site and, therefore, proposed this pilot study.

The major findings of plume characterization activities to date, reported in the MDA L investigation report (LANL 2005, 90512) include the following:

- Releases from disposal units at MDA L resulted in a subsurface vapor-phase VOC plume extending beneath the site and beyond the boundary of MDA L.
- Vertically, the 10 ppmv TCA contour is approximately 300 ft bgs; VOCs have been detected at low ppbv concentrations in vapor samples from the basalt.

- The long-axis extent of the plume along the length of the mesa, as defined by the 10 ppmv TCA contour, has fluctuated between 700 and 1000 ft. The short-axis extent is defined by the width of the mesa (approximately 450 ft across).
- VOCs are transported from the source areas in the vapor phase.
- TCA is the primary constituent of the VOC plume.
- TCA concentrations vary across the plume.
- The plume is changing very little in area or contaminant concentrations since 1999.
- Uncertainties associated with potential increases in the source term as a result of container failure in the future are significant.

3.0 METHODOLOGY

The primary goal of the pilot test was to provide information necessary to perform the following activities during the CME to evaluate SVE as an alternative for remediating the MDA L vapor plume:

- specifying system components such as vacuum blowers, extraction boreholes, effluent air treatment, pipes and other system components
- verifying operating conditions such as extraction vacuum levels, airflow rates, radius of influence, contaminant vapor concentrations
- estimating the extraction rates and residual source-term management (e.g., system pulsing)
- evaluating costs

3.1 SVE Pilot Study Scope

This pilot consisted of the following activities:

- installing two boreholes, located in the vicinity of each of the two source zones, that were drilled and configured specifically to be used as vapor extraction boreholes for this project and
- performing active extraction and off-gas treatment from 3 to 4 weeks at each borehole.

The pilot study data will be analyzed to determine extraction rates for reducing the extent of the plume. In addition, the study will assess the ability of an SVE system to respond to potential releases from the inventory resulting from container failure in the future.

3.2 SVE Pilot Test Summary

Two extraction boreholes were installed at MDA L: SVE-West, in the vicinity of shafts 26–34; and, SVE-East, in the vicinity of Shafts 1–25. Each borehole was constructed with an extraction interval extending from 65 ft bgs to approximately 215 ft bgs. The upper 65 ft was cased with steel, and the casing was grouted in place; a basal grout plug was emplaced to eliminate the potential for short circuiting from below. The surface casing was set in concrete. Figure 3.2-1 shows the placement of the proposed extraction boreholes. The boreholes drilled for the pilot study were logged to provide information on subsurface stratigraphy.

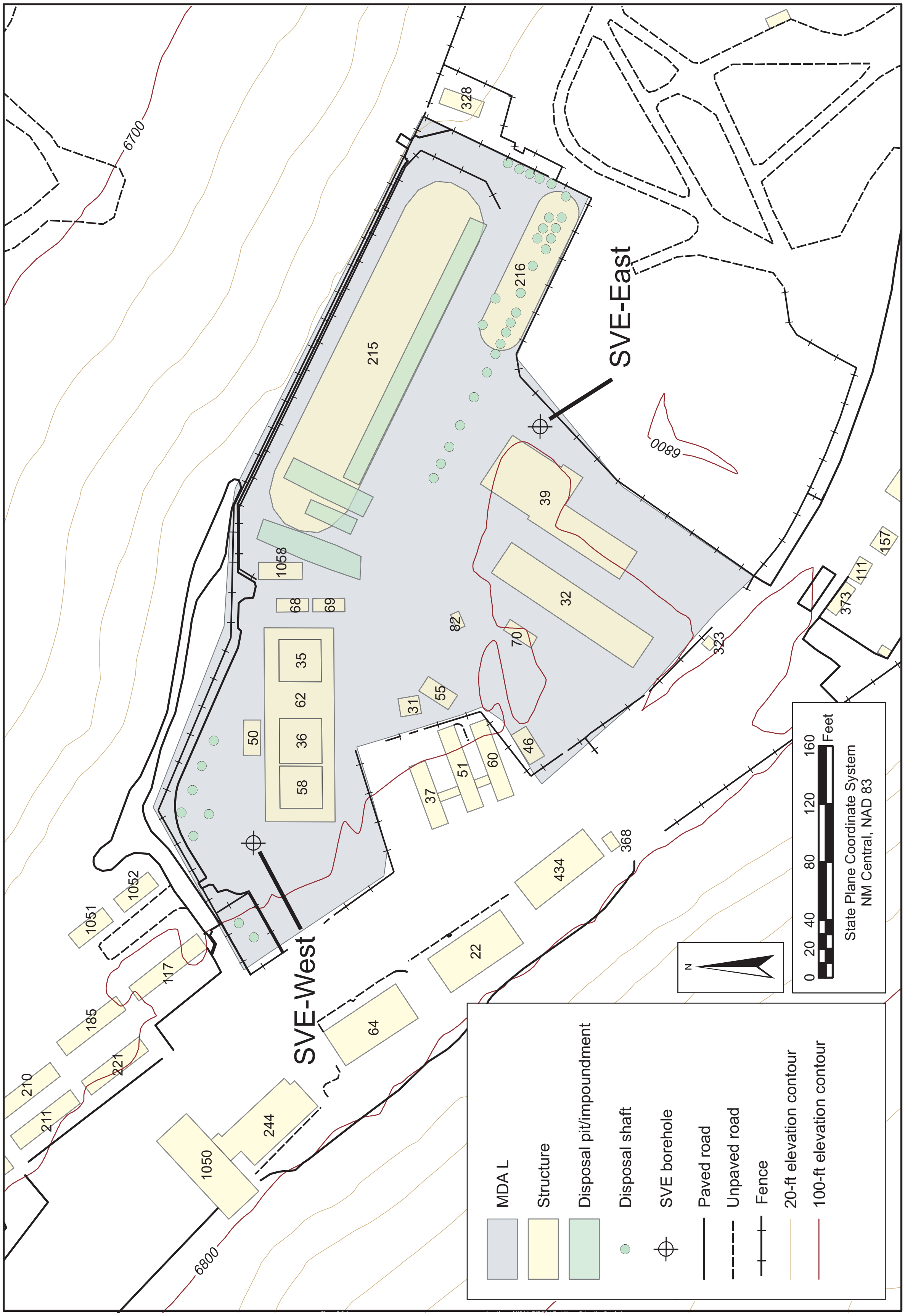


Figure 3.2-1. Locations of MDA L SVE Pilot Test Vapor Extraction Boreholes

A Brüel & Kjær (B&K) 1302 photoacoustic multgas analyzer was used to monitor primary contaminant concentrations (TCA, trichloroethylene [TCE], Freon-11, and tetrachloroethylene [PCE]), as well as carbon dioxide and water vapor in extracted pore gas and in sampling ports in the SVE monitoring boreholes. The surrounding boreholes were monitored using the B&K, and differential pressure readings, measure in kilopascals (kPa) were collected using a Dwyer Series 475 Mark III Digital Manometer, which measures the difference between surface (i.e., atmospheric) and subsurface pressures.

The Laboratory's meteorology group provided the atmospheric data, including temperature, relative humidity, barometric pressure, that were collected at the TA-54 weather station. Once active extraction ceased, several rounds of pore gas monitoring were conducted to show near-field rebound.

Extraction process measurements (including the total flow from the borehole, borehole vacuum, extraction air temperature and relative humidity) were collected using a Campbell Scientific CS-13X datalogger. During the test, air flow from the extraction borehole was monitored using a Dwyer Series PE inline orifice plate flow meter with a Dwyer Model 677-8 differential pressure transducer. The orifice plate measures air flow by monitoring the differential pressure across the plate. The air flow rate was determined by closing the SVE system's dilution valve to the differential pressure corresponding with the desired flow rate (calculated per equations provided by the manufacturer, Dwyer). Temperature and relative humidity were collected using a Viasala HMP45AC humidity and temperature probe. Vacuum pressure at the top of the extraction borehole was monitored using a 0–20 in. of mercury (in.-Hg) vacuum gauge.

The contaminated vapor effluent was directed for treatment through two epoxy-lined steel canisters containing 400 lbs of granular active carbon ([GAC] supplied by the US Filter Corporation) connected in series. The treated effluent was released from the second GAC vessel through a 10-ft tall stack. Effluent samples were collected from between the two treatment vessels and from the stack to ensure maximum GAC was used while maintaining compliance with site emission limits.

Finally, to calculate total VOCs, it was assumed that the VOCs being monitored by the B&K multigas analyzer comprise approximately 80% of the mass of the plume beneath MDA L, based on ongoing pore-gas monitoring at MDA L.

4.0 SVE PILOT TEST

Active extraction at SVE-West occurred from June 14 to July 13, 2006; extraction was interrupted from June 17 to June 21, 2006, to repair a broken motor pulley. Active extraction at SVE-East took place from July 18 to August 9, 2006; the system operated continuously during this period.

4.1 SVE-West

The pilot test period of the SVE-West test lasted 28.7 days, with 24.8 days of active extraction because repairs needed to be made to the pulley. The air flow rate for the test was initially set to approximately 95 standard cubic feet per minute (scfm); the corresponding vacuum imparted on the extraction borehole was 3.9 in.-Hg. On July 7, 2006, at 22.9 days (19.1 days of extraction), the air flow rate was increased to approximately 105 scfm, with a vacuum level of 4.4 in.-Hg. This level was near the maximum capacity of the SVE unit; the dilution valve was approximately a quarter turn from being completely closed. B&K and manometer readings were collected from boreholes 54-24240, 54-02001, 54-02031, and 54-02021 to evaluate the radius of influence of the SVE system and to assess the overall impact of extraction on the VOC plume. Graphs showing the manometer readings for all boreholes and ports monitored and correlation plots showing correlations between various chemicals are provided in Attachment 1.

During the SVE-West test, more than 500 lbs of VOCs were extracted from the subsurface. Figure 4.1.1 shows the TCA concentrations in the extraction borehole during the test. Additional graphs in Attachment 1 show TCA, TCE, Freon, and PCE concentrations at the extraction borehole during the test. Figure 4.1.2 shows the cumulative TCA and estimated cumulative VOCs removed.

Figure 4.1.1 Extraction Well TCA Concentration Decline Curve

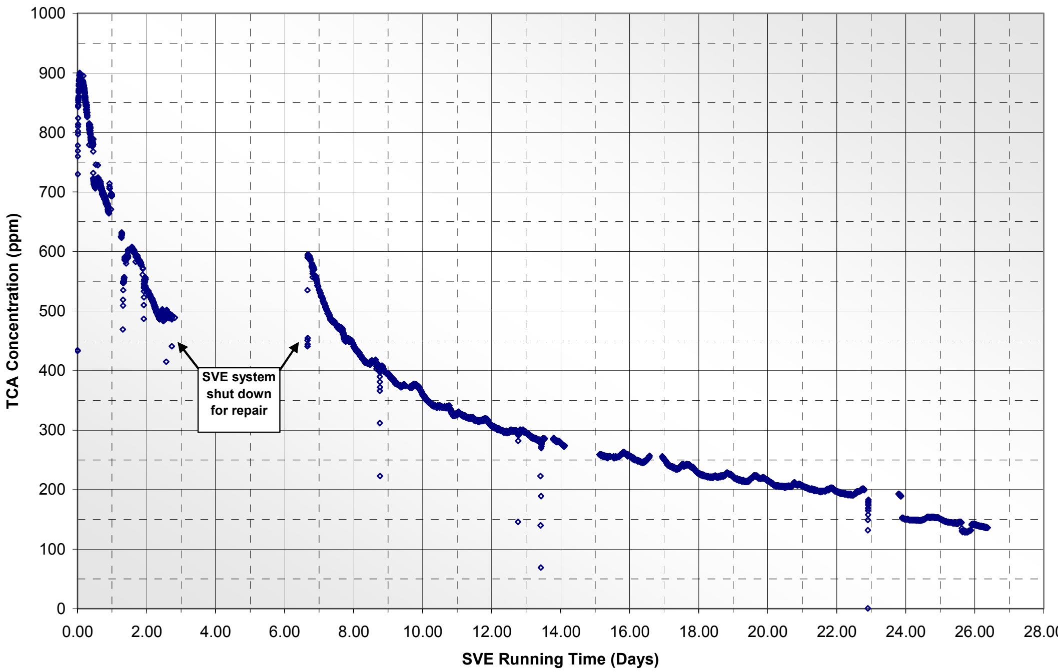
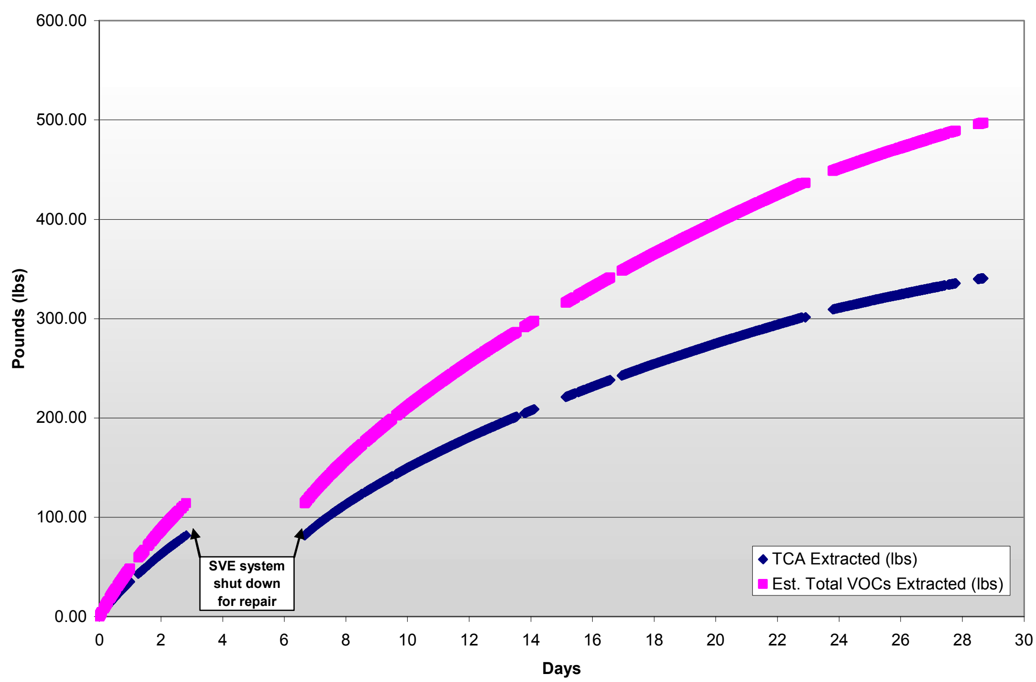


Figure 4.1.2 TCA and Total VOCs Estimated Pounds Extracted



Borehole 54-24240

Borehole 54-24240 was the closest monitoring point to the SVE-West extraction borehole, at a distance of 26 ft. Subsurface monitoring ports were located at the following depths: 25 ft, 50 ft, 75 ft, 100 ft, and 117 ft. Boxplots of manometer data showing background versus test-period readings indicate a strong pressure response with all port depths shifting to negative differential pressures. Figure 4.1.3 shows the strong pressure response at all depths, with the strongest response in the 50 ft to 100 ft interval.

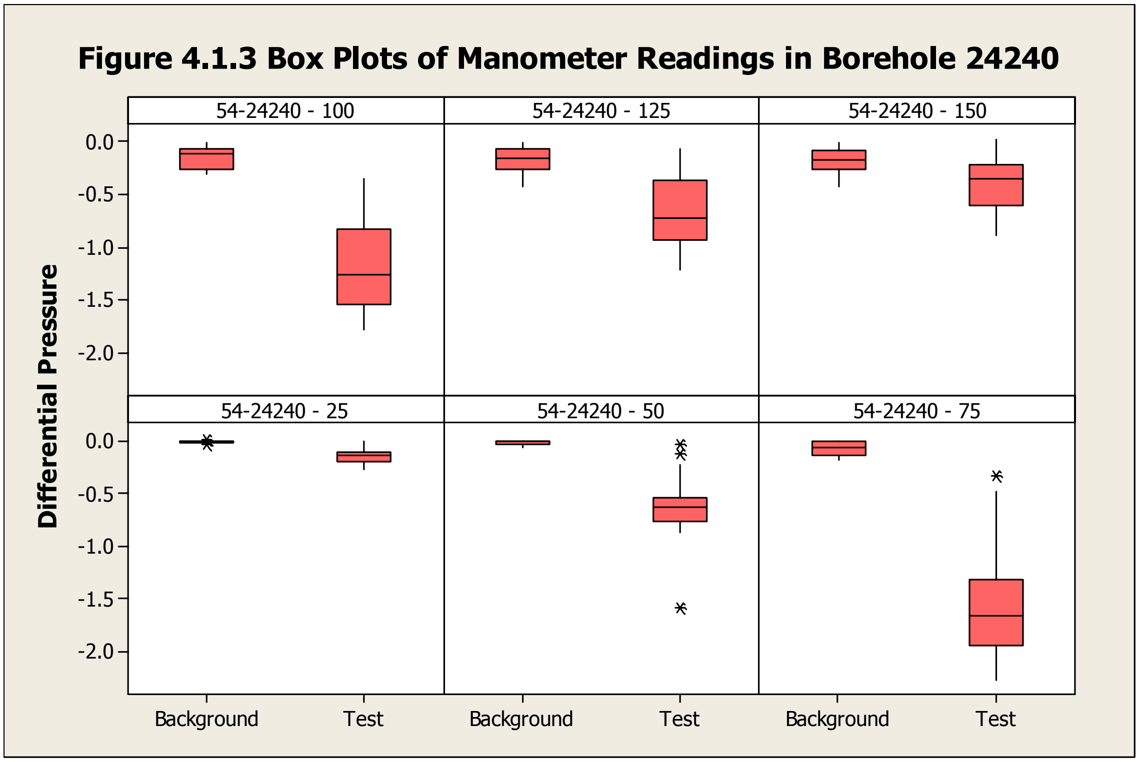


Figure 4.1.4 shows manometer readings from 54-24240. The strong response to the test is evidenced by the quick return of the differential pressure readings to near 0 kPa during the shutdown period from June 18 to June 21, 2006, and at the end of the test following final shutdown. Manometer readings versus time for the individual ports at 54-24240 are provided in Attachment 1.

Figure 4.1.5 shows TCA concentrations (ppm) versus time in borehole 54-24240. The graph shows TCA trends similar to those in the extraction borehole: TCA concentrations decrease at a fairly rapid rate at the beginning of the test. When the system was shut down for approximately four days for repairs , TCA in 54-24240 rebounded to near pre-test conditions after four days of extraction. Approximately two weeks after extraction ceased, TCA in ports at 75 ft, 100 ft, 125 ft, and 150 ft had rebounded to pre-test levels; however, the 25 ft and 50 ft ports were still well below pre-test levels. Additional scatterplots showing concentration trends for individual port depths and other compounds monitored during the test are provided in Attachment 1.

Figure 4.1.4
Scatter Plot of Manometer Readings from Borehole 24240

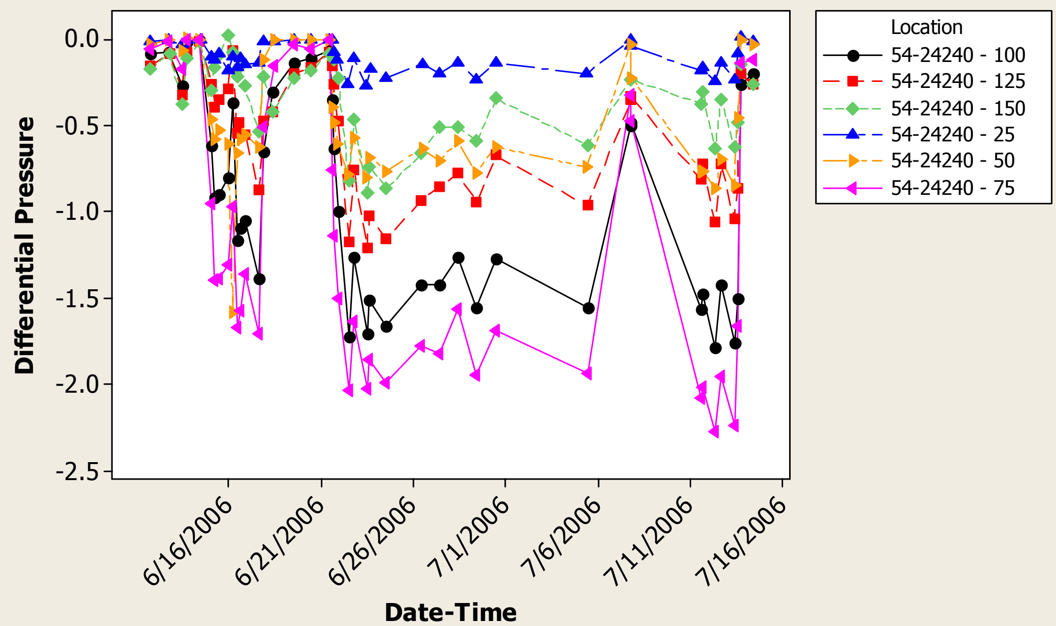
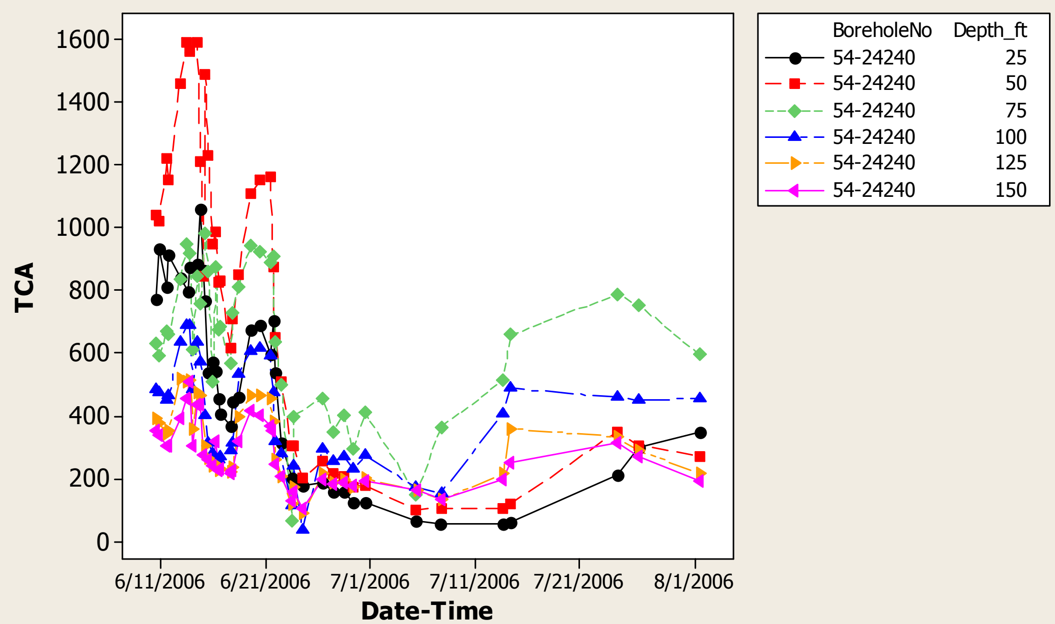


Figure 4.1.5 TCA Readings in Borehole 24240



Borehole 54-02001

Borehole 54-02001 was the second closest monitoring point to SVE-West extraction borehole, located at a distance of 57 ft. Subsurface monitoring ports were located at the following depths: 20 ft, 40 ft, 80 ft, 100 ft, 120 ft, and 200 ft. Figure 4.1.6 shows manometer readings from 54-02001. The response to the test is evidenced by the rapid response of the manometer readings during the June 18 to June 21, 2006, shutdown period and at the end of the test following final shutdown. The graph shows that the response was strongest in the 40 ft, 80 ft, and 100 ft ports. Manometer readings versus time for individual ports are provided in Attachment 1.

Figure 4.1.6 Scatterplot of Manometer Readings (kPa) in Borehole 02001

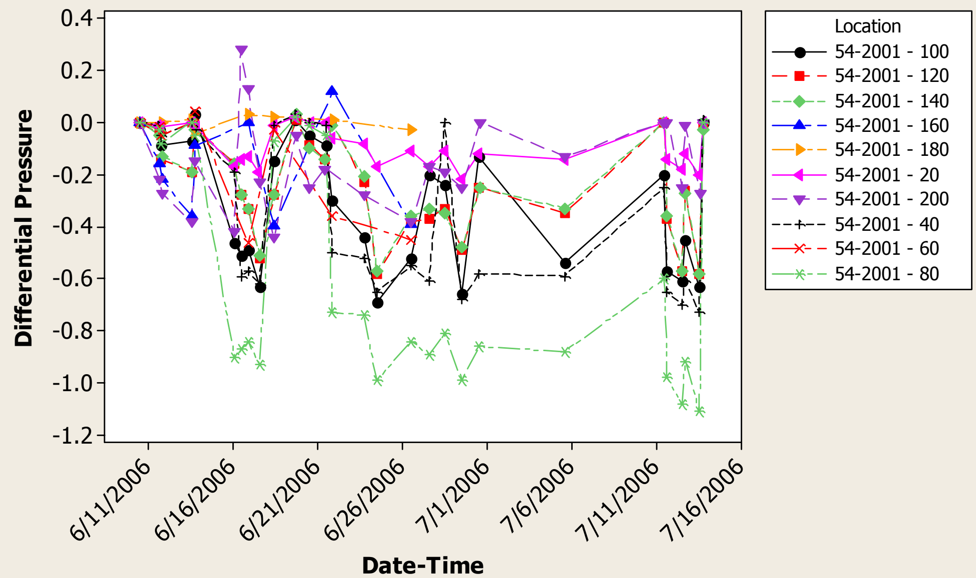
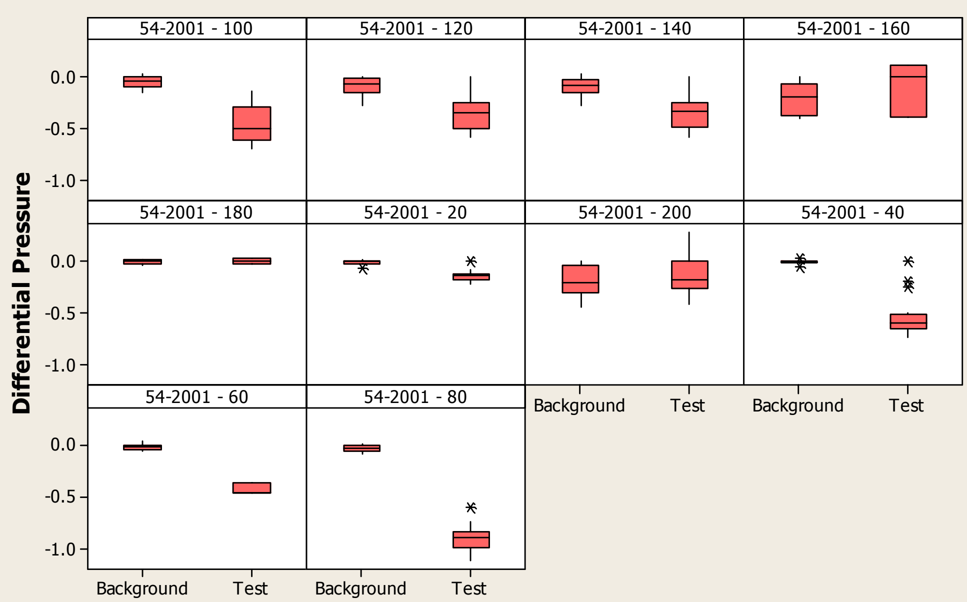


Figure 4.1.7 compares background and extraction period differential pressure readings in borehole 54-02001. The manometer data indicate a pressure response with all port depths shifting to negative differential pressures, except at the 200-ft port.

Figure 4.1.7 Box Plots of Manometer Readings from Borehole 02001



4.2 SVE-East

The extraction period for the SVE-east test started on July 18, 2006, and stopped on August 9, 2006, for a total of 21.9 days. The air flow rate for the test was set to approximately 105 scfm (the maximum capacity of the SVE system), resulting in a vacuum level of 4.9 in.-Hg. B&K and manometer readings were collected from boreholes 54-02087, 54-02089, 54-24243, 54-02002, and 54-24244 to evaluate the radius of influence of the SVE system and to assess the overall impact of extraction on the VOC plume. Graphs showing the manometer readings for all boreholes and ports monitored and correlation plots showing correlations between various chemicals are provided in Attachment 2.

Figure 4.2.1 shows TCA concentrations (ppmv) in the pore gas extracted from the subsurface. TCA concentrations peaked at 294 ppmv after 26 min and declined to 157 ppmv at the end of the extraction phase of the test.

Figure 4.2.1 SVE-East Extraction Well TCA Concentration Decline Curve

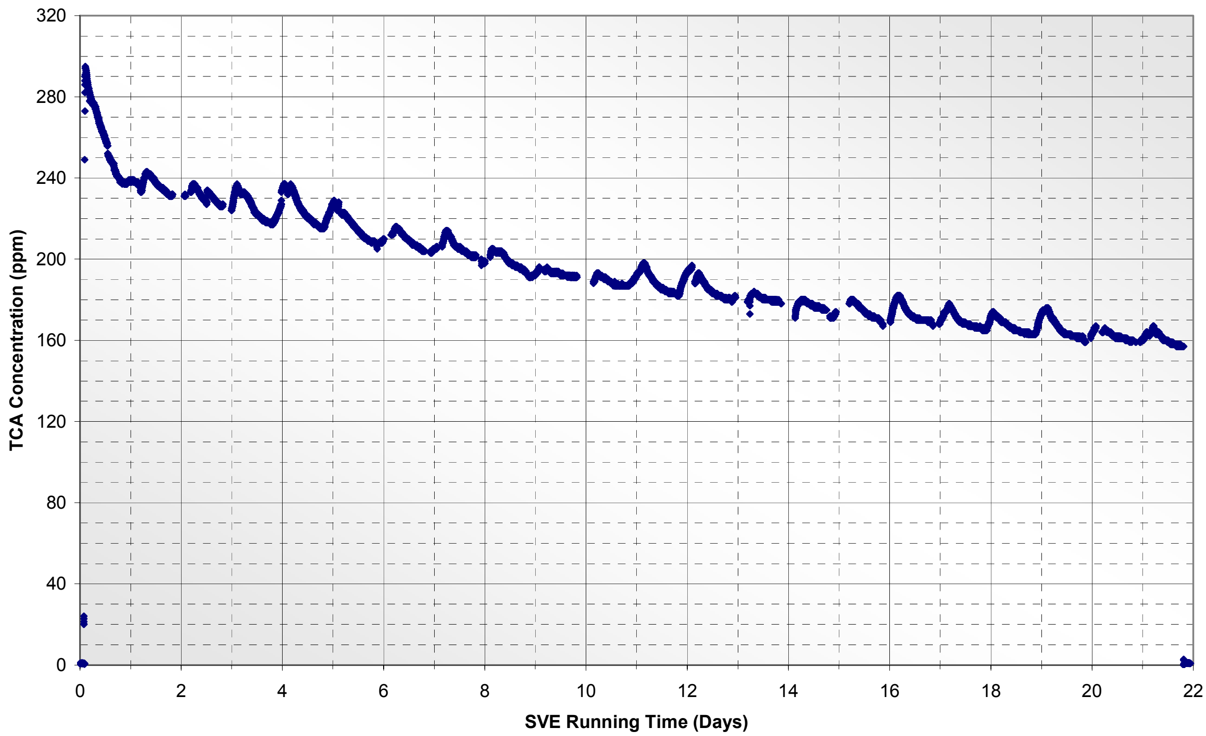


Figure 4.2.2 shows the trend of total VOCs extraction from the SVE-East extraction borehole. During the test, approximately 175 lbs of TCA and approximately 300 lbs of total VOCs were extracted from the subsurface.

Borehole 54-24243

Borehole 54-24243 was approximately 53 ft east of the SVE-East extraction borehole. Subsurface monitoring ports were located at 25 ft, 50 ft, 75 ft, 100 ft, and 117 ft. Figure 4.2.3 shows the measurable differential pressure response in the deeper ports, with the strongest response at 100 ft and 117.5 ft.

Figure 4.2.2 SVE-East Extraction Borehole Pounds of TCA and Total VOCs Extracted

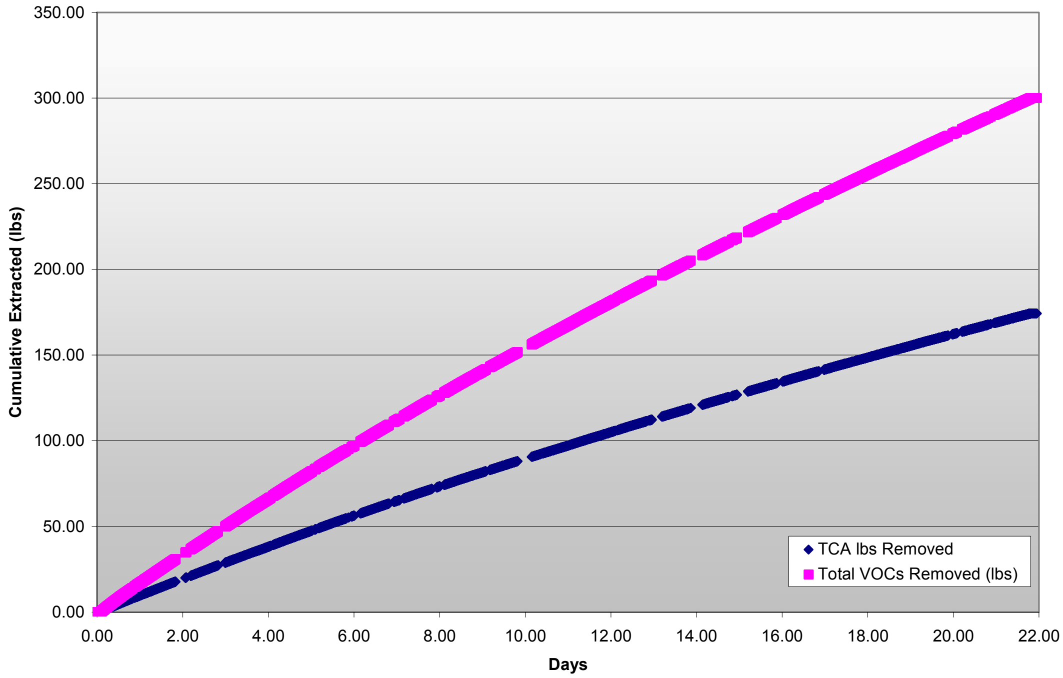


Figure 4.2.3 Box Plots of Manometer Readings in Borehole 24243

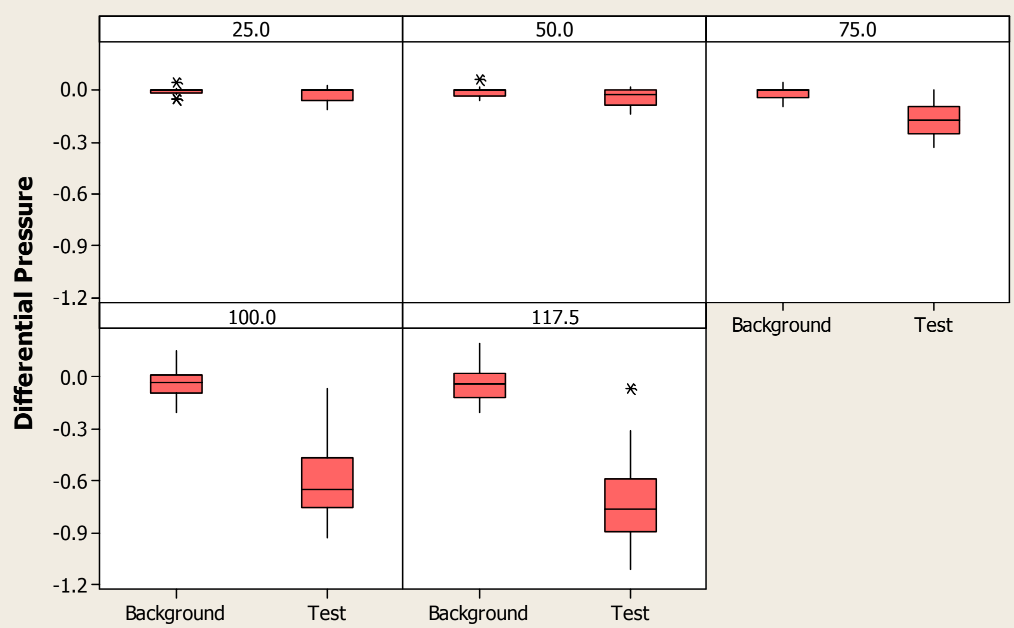


Figure 4.2.4 confirms the pressure response in the 75 ft, 100 ft, and 117.5 ports.

Figure 4.2.4
Scatter Plots of Manometer Readings in Borehole 54-24243

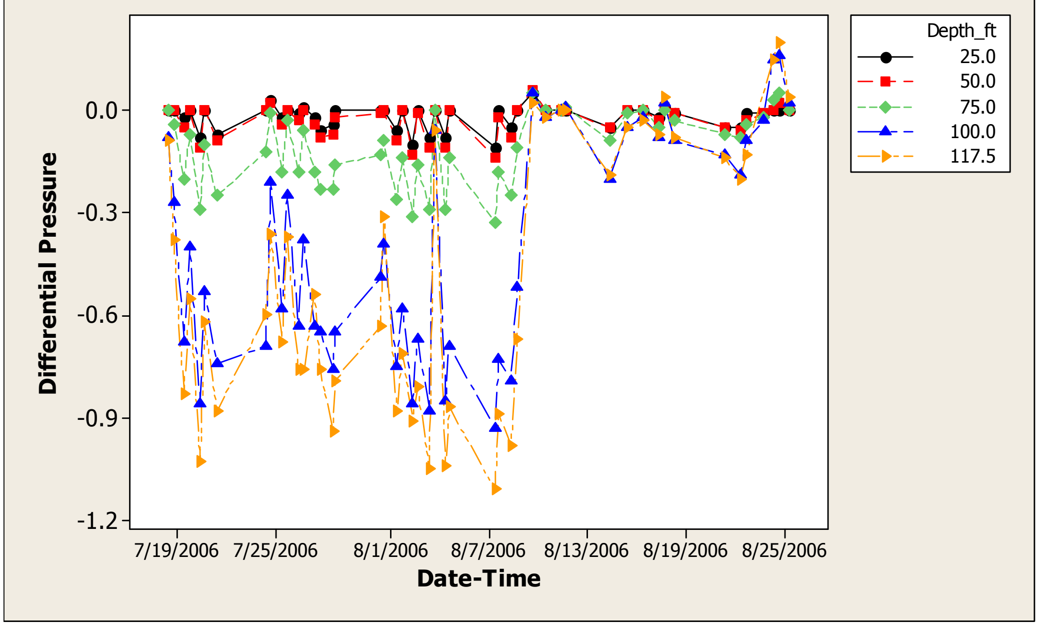
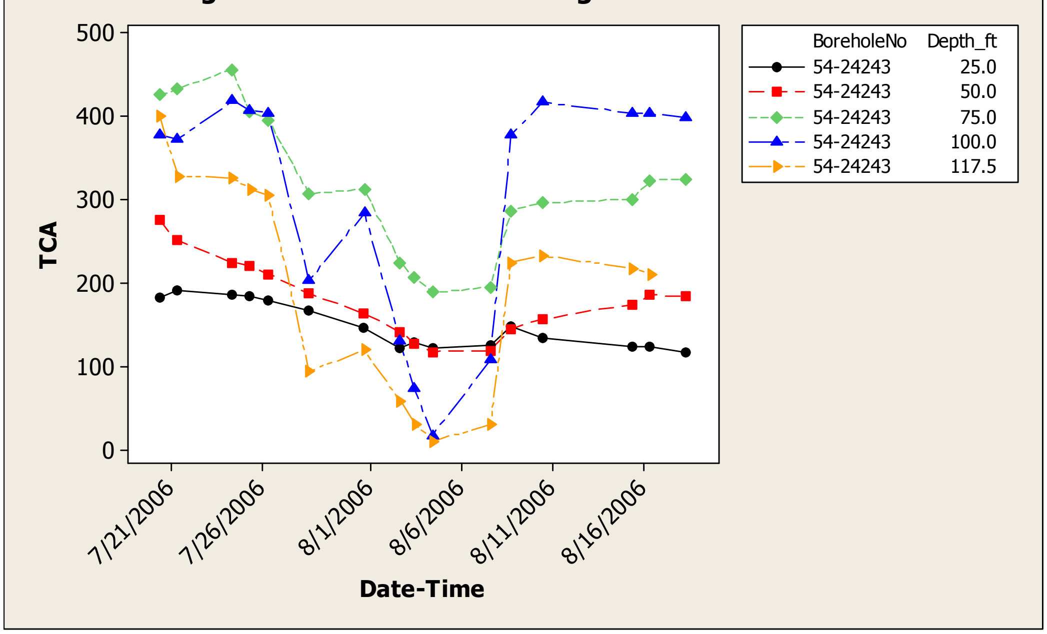


Figure 4.2.5 shows the TCA B&K readings in borehole 54-24243. The TCA trends confirm a response to the SVE-East vacuum. Additional plots are provided in Attachment 2.

Figure 4.2.5 TCA B&K Readings in Borehole 24243



Borehole 54-02002

Borehole 54-02002 was approximately 132 ft east of the SVE-East extraction borehole. Monitoring ports were located at 20 ft, 40 ft, 60 ft, 80 ft, 100 ft, 120 ft, 140 ft, 157 ft, 180 ft and 200 ft. All ports were available for pressure testing; however, only the 60 ft, 100 ft, 140 ft, and 200 ft ports could be sampled with the B&K because the other ports were partially sealed. Figure 4.2.6 shows differential readings from borehole 54-02002, illustrating a measurable differential pressure response in ports below 60 ft.

Figure 4.2.6 Box Plots of Manometer Readings from Borehole 02002

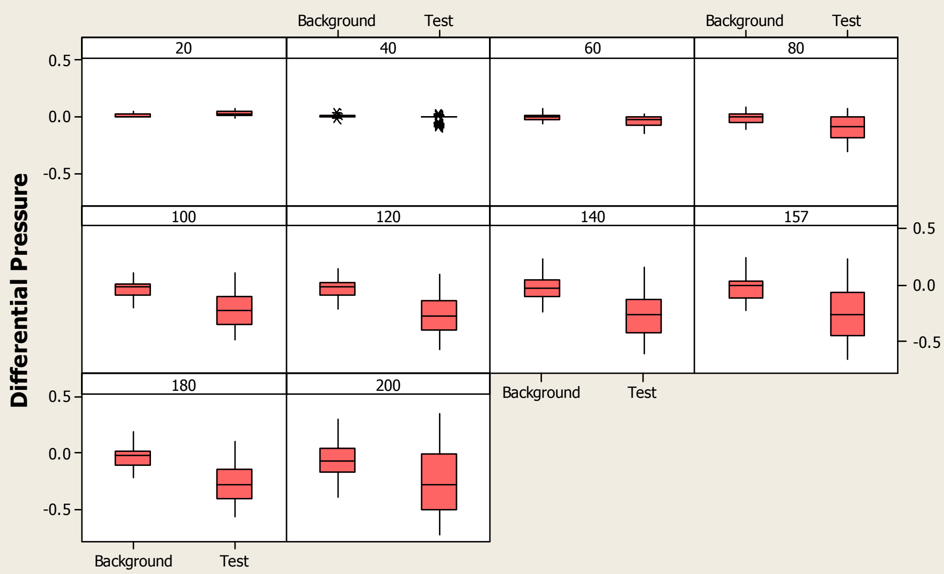


Figure 4.2.7 shows manometer readings confirming the differential pressure response during the test.

Figure 4.2.7 Scatterplot of Manometer Readings from Borehole 02002

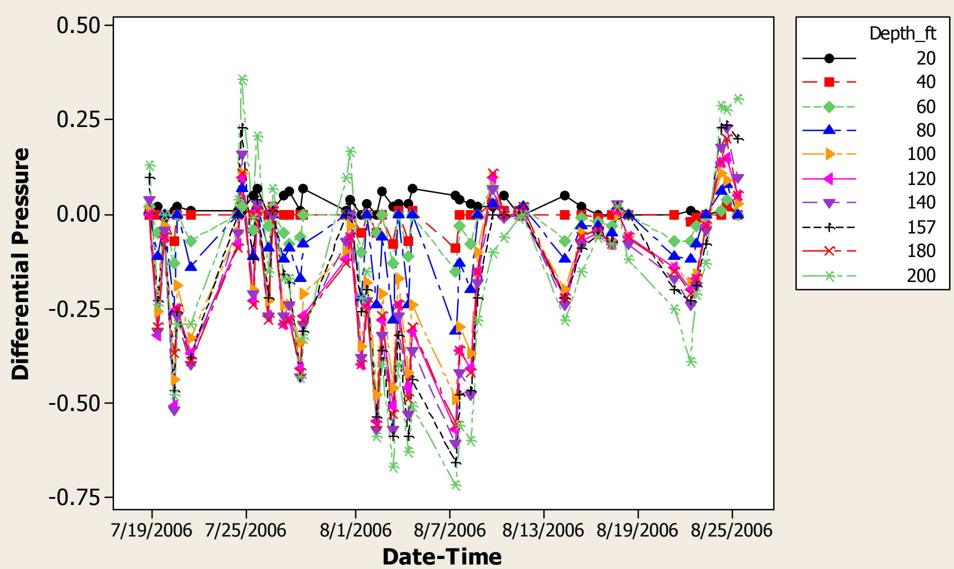
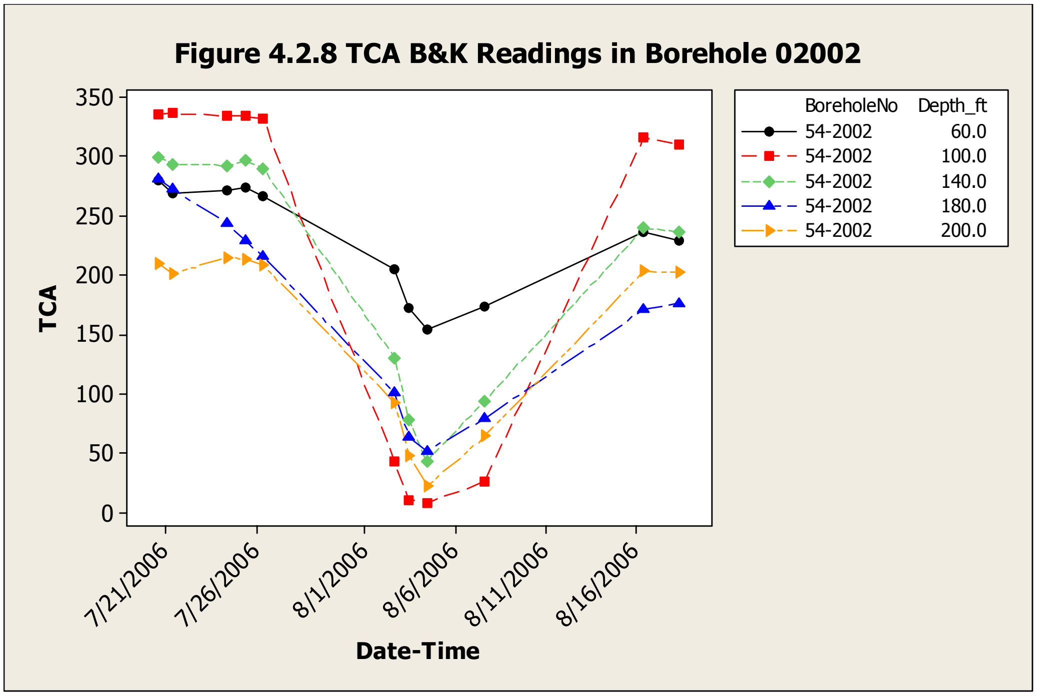


Figure 4.2.8 shows TCA B&K readings in ports in borehole 54-02002, confirming the impact of vacuum extraction at the SVE-East extraction borehole.



Borehole 54-02089

Borehole 54-02089 was located approximately 59 ft north of the extraction borehole, immediately adjacent the eastern shaft field. Monitoring ports were located at 13 ft, 31 ft, 46 ft, and 86 ft below the surface. Figure 4.2.9 shows the differential pressure readings in 54-02089.

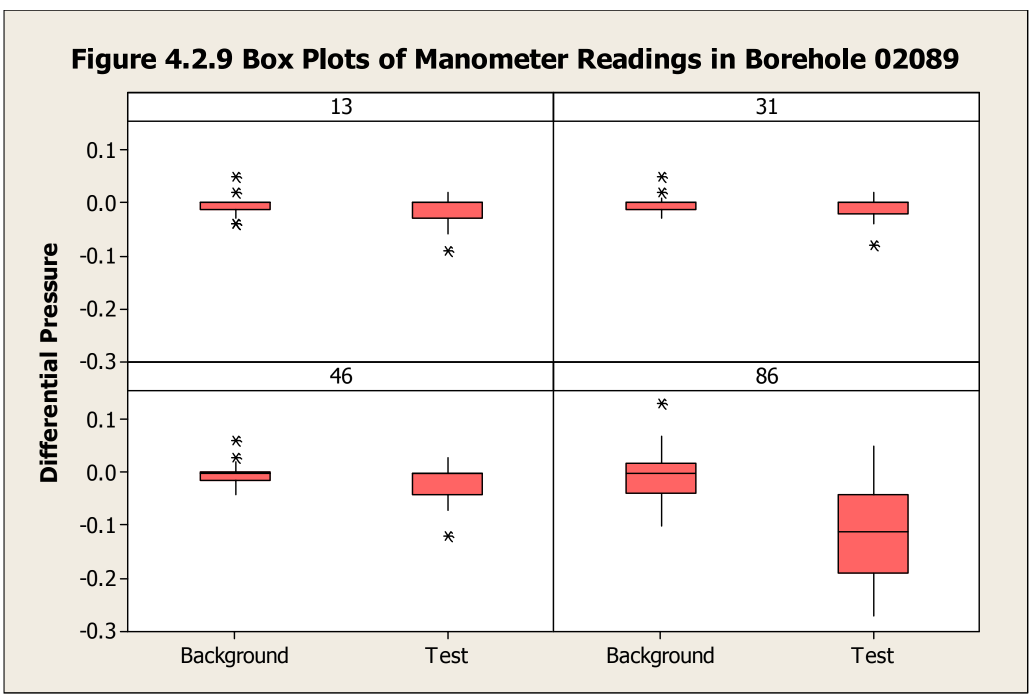
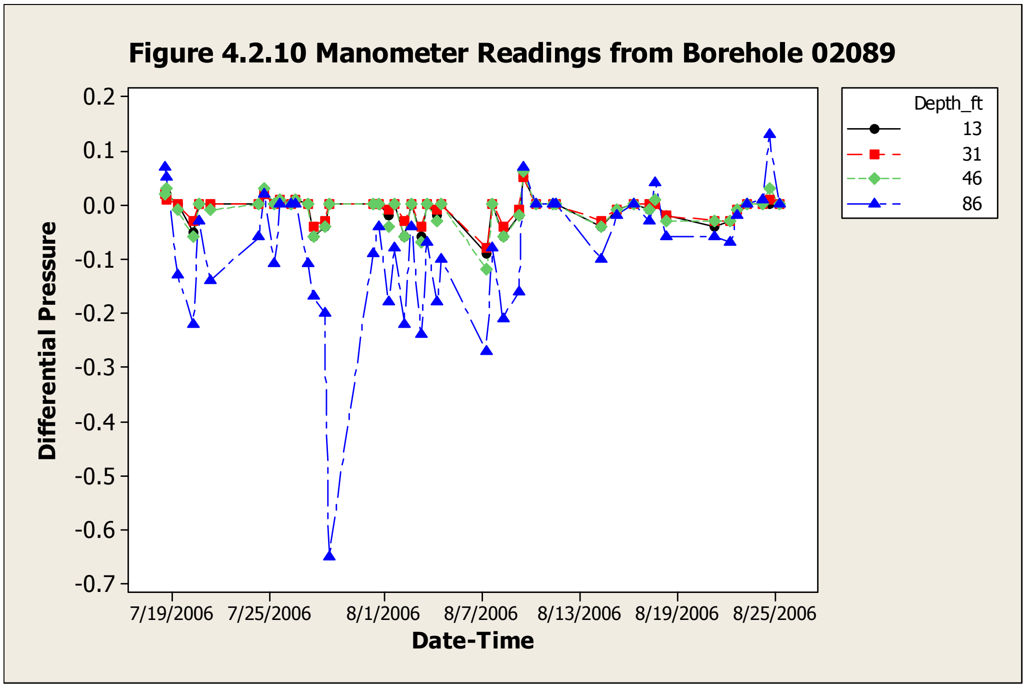
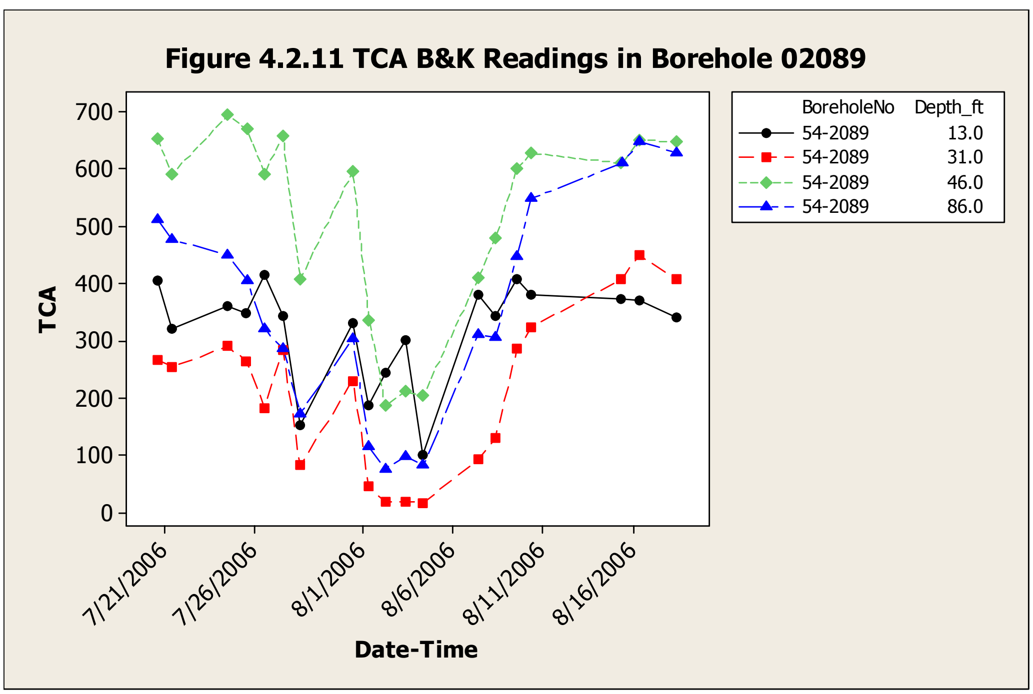


Figure 4.2.10 shows differential pressure versus time in borehole 54-02089.



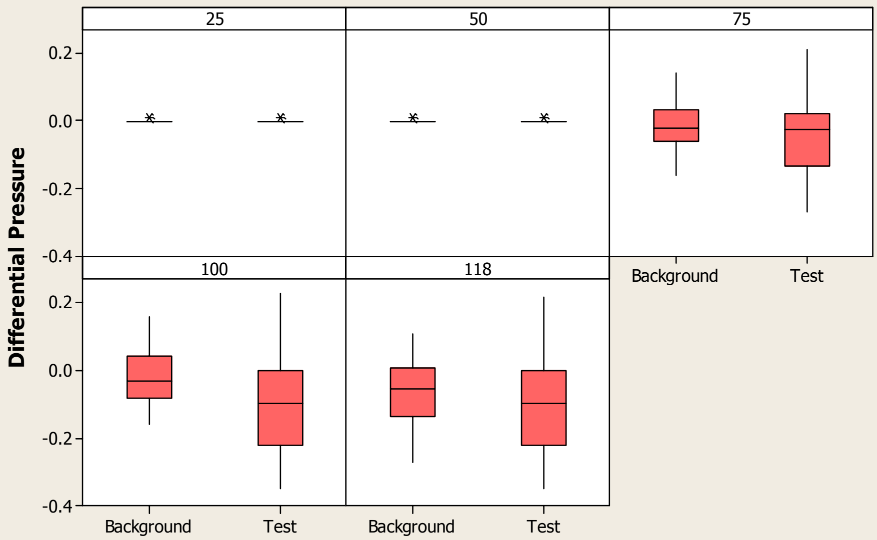
Both graphs show that during the extraction portion of the test, differential pressure readings were significantly different only in the 86 ft port. Figure 4.2.11 shows TCA versus time in ports in borehole 54-02089. This graph shows that, despite the lack of a strong pressure response, TCA concentrations were impacted by the vacuum extraction process. All ports showed a decrease in concentrations during the extraction phase of the test, returning to pre-test levels within a week after the vacuum blower was shut off.



Borehole 54-24244

Borehole 54-24244 was the farthest monitoring borehole from the SVE-East extraction borehole, located approximately 200 ft northeast. Monitoring ports were located at 25 ft, 50 ft, 75 ft, 100 ft, and 118 ft. Figure 4.2.12 shows manometer readings in borehole 54-24244.

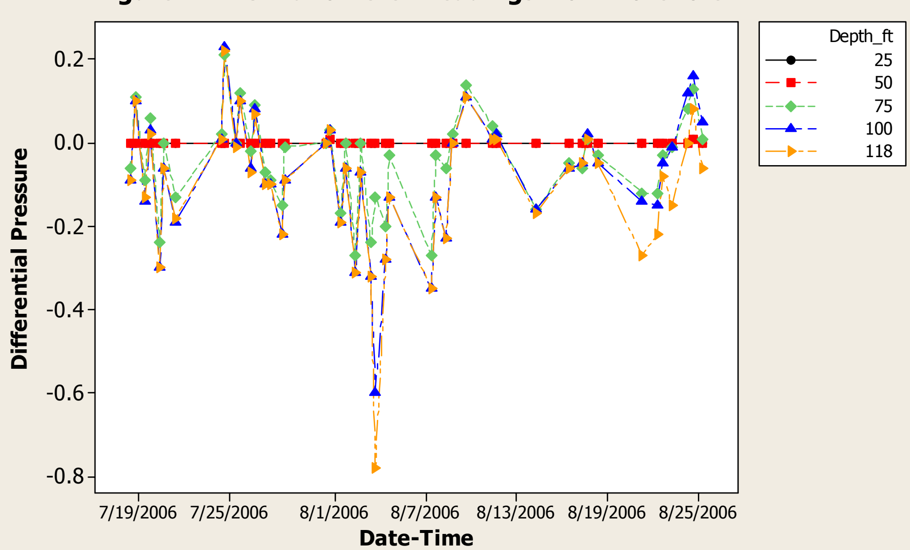
Figure 4.2.12 Box Plots of Manometer Readings from Borehole 24244



As the plots indicate, the test period showed more highly differential pressure readings, but the background and test median values were slightly lower in the 100 ft and 118 ft ports.

Figure 4.2.13 shows manometer readings during the test period, illustrating a potential pressure response in the deeper ports.

Figure 4.2.13 Manometer Readings from Borehole 24244



5.0 RECOMMENDATIONS FOR DATA ANALYSIS

The data from the MDA L SVE pilot project will be used to validate the existing site scale numerical model (Stauffer et al. 2005, 69794) to gain a more complete understanding of how the dynamic SVE pumping affects flow and transport within the mesa below MDA L. Once the dynamic plume behavior is validated, the model will be used to design an SVE system to control future plume growth. Future plume growth could be affected by several processes such as continued long term leakage of VOC from drums, increased leakage from the drums decaying over time, and catastrophic release of VOC from the sudden failure of liquid-filled drums. The simulations will allow evaluation of these scenarios and provide a tool to determine a path forward if monitoring data show that any of these events may have occurred.

The site scale model will be calibrated to the pre-test concentration data before the end of October 2006, and simulations of extraction rates will be finished by the end of November 2006. The final reports on modeling and analysis are scheduled to be finished by early December 2006.

6.0 CONCLUSION

The SVE pilot test provided sufficient data to validate the conceptual model for vapor transport at MDA L. The validated model will be used to provide extraction rates to the contractor writing the CME for MDA L. The extraction rates will be used to complete a conceptual design of a SVE system to remediate the VOC plume at MDA L. In addition, an estimated 800 lbs of VOCs were extracted during approximately 45 days of active vacuum extraction.

7.0 REFERENCES

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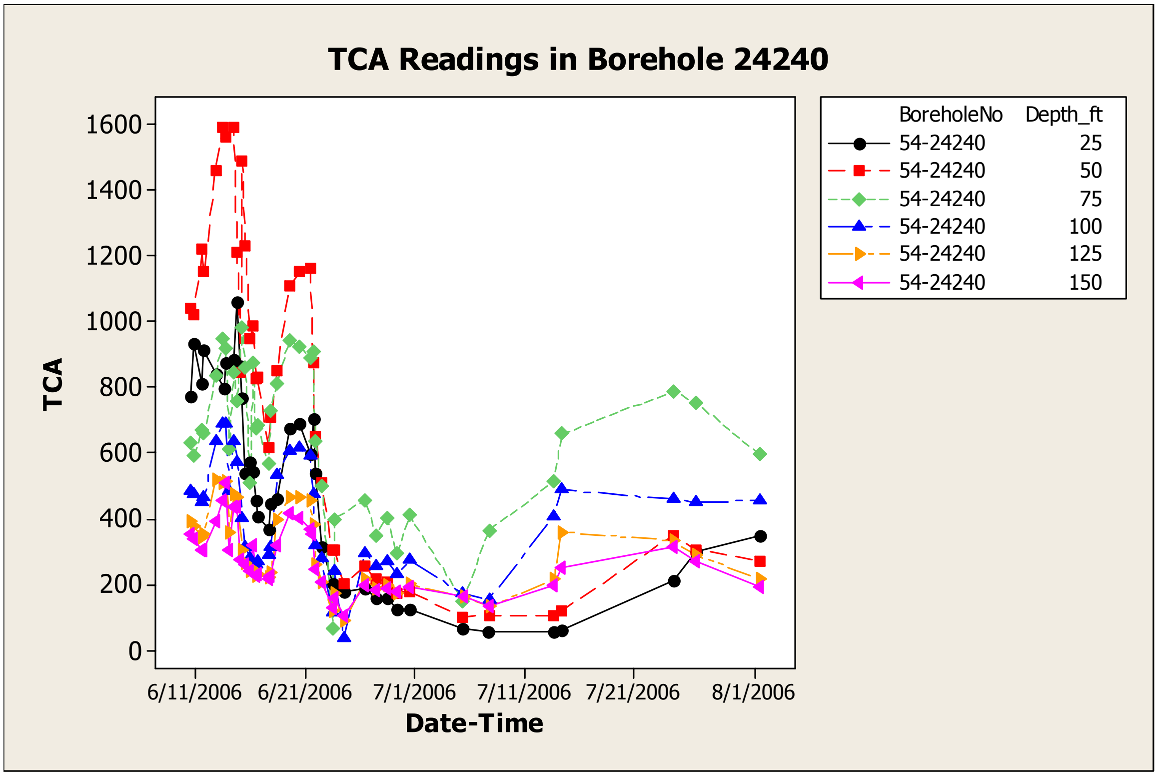
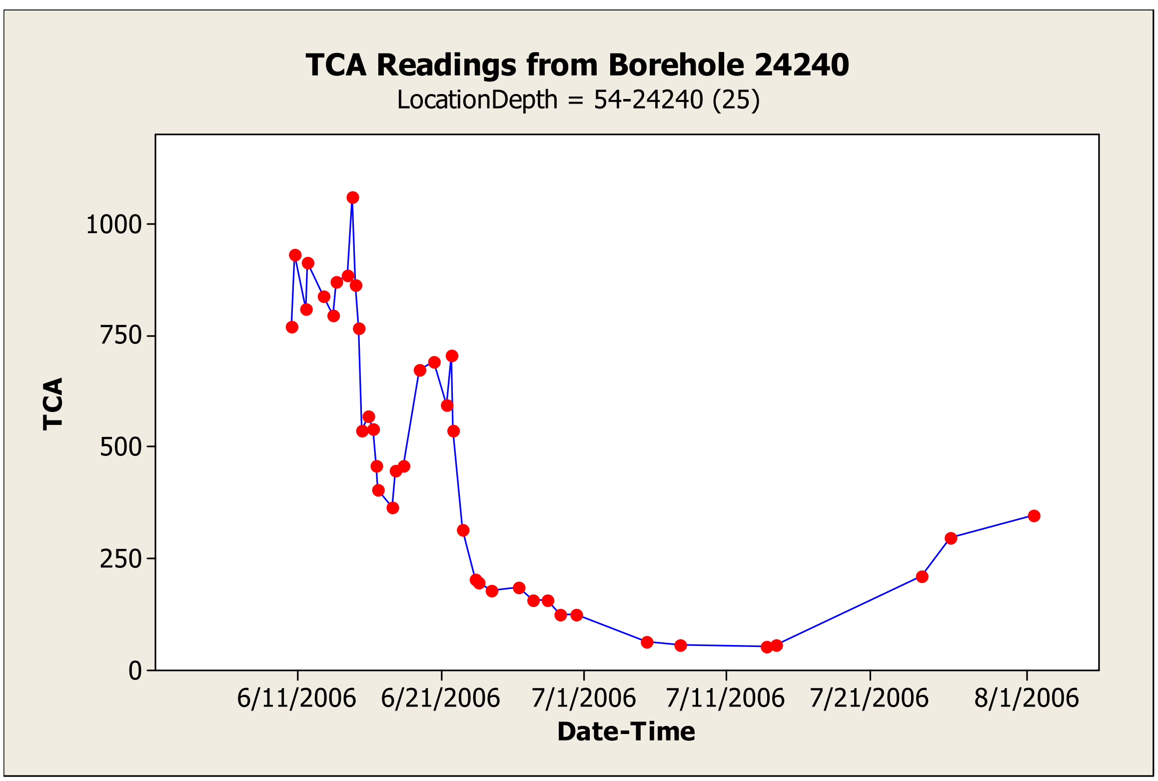
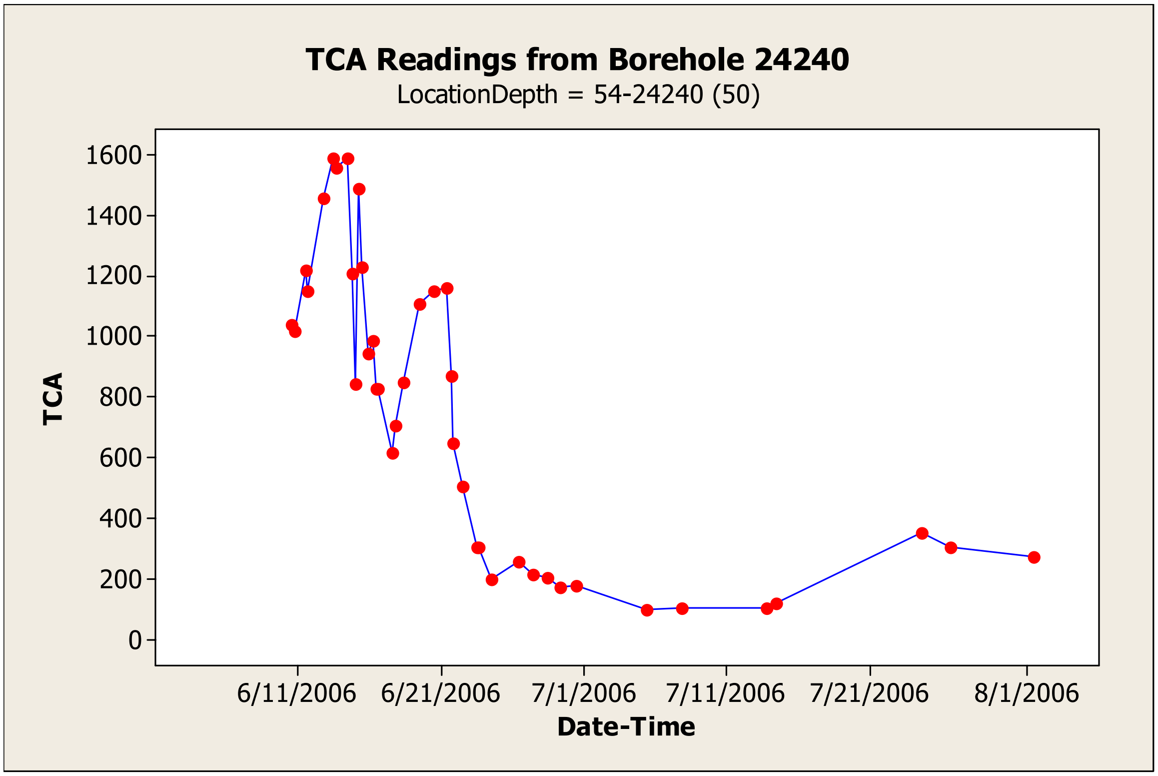
Attachment 1

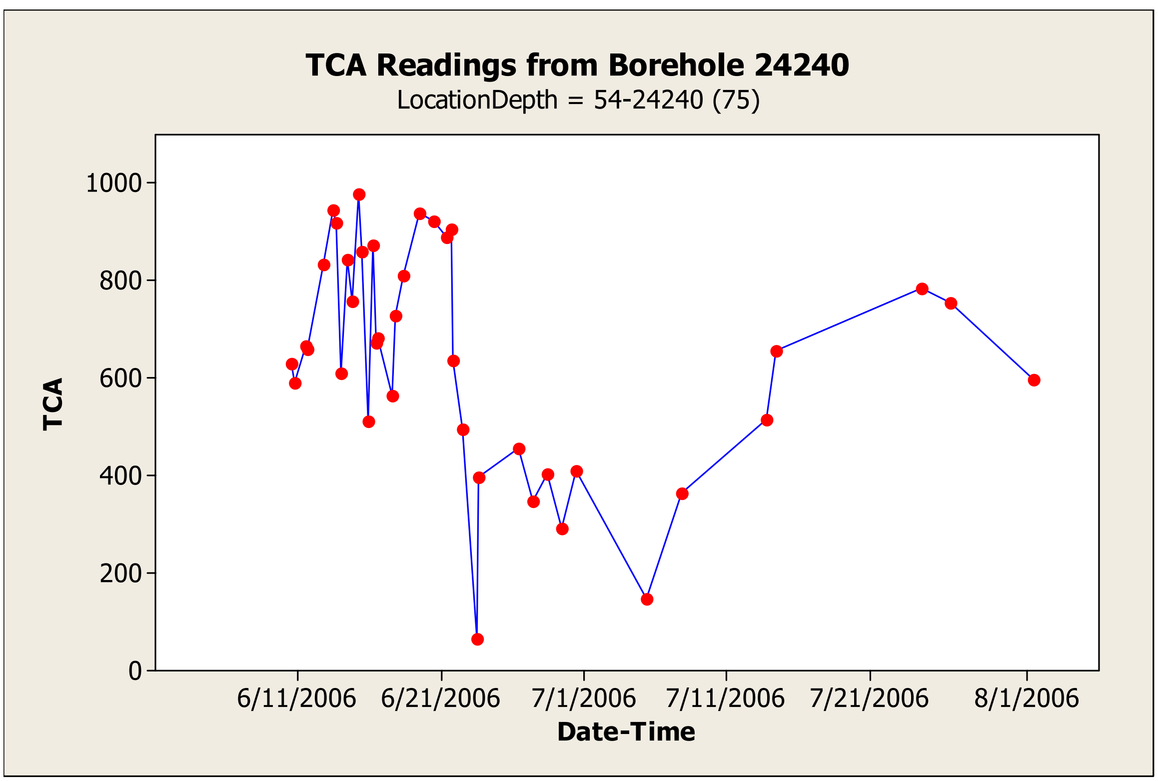
SVE West
Additional Figures Showing
Manometer Readings and Chemical Correlations

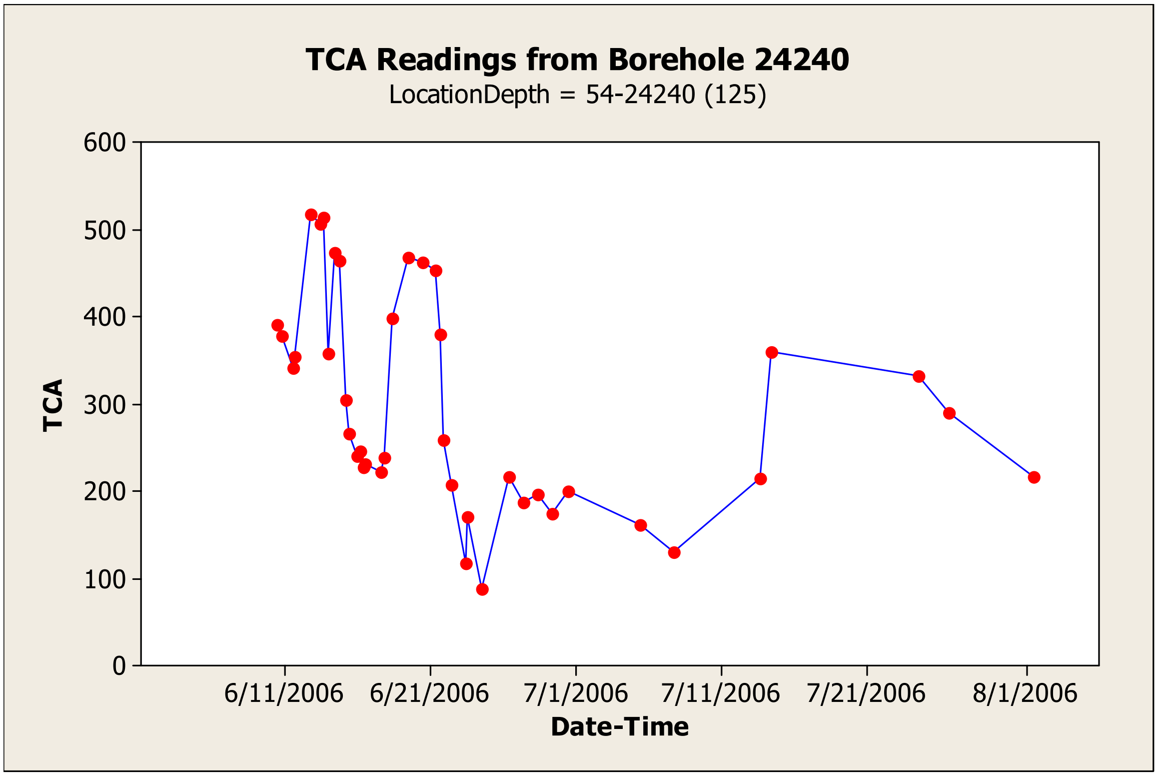
TCA B&K Readings in Borehole 54-24240

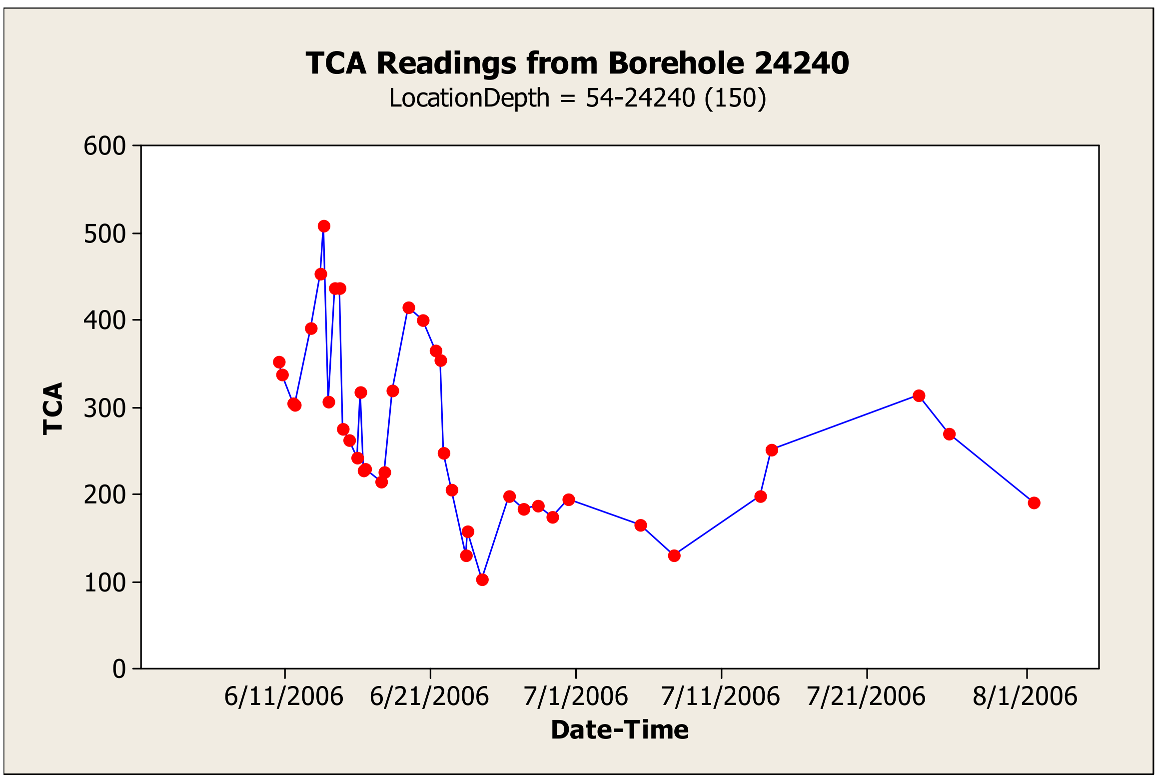




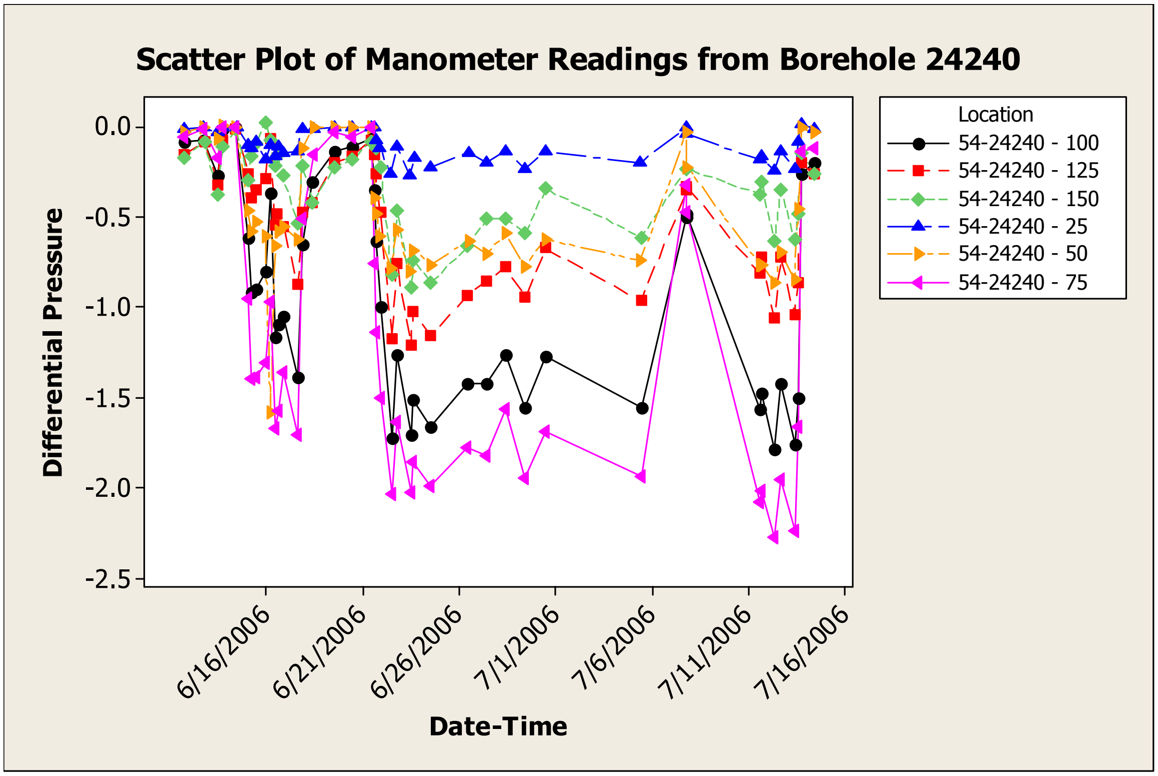

TCA Readings from Borehole 24240
LocationDepth = 54-24240 (50)
TCA
0
200
400
600
800
1000
1200
1400
1600
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

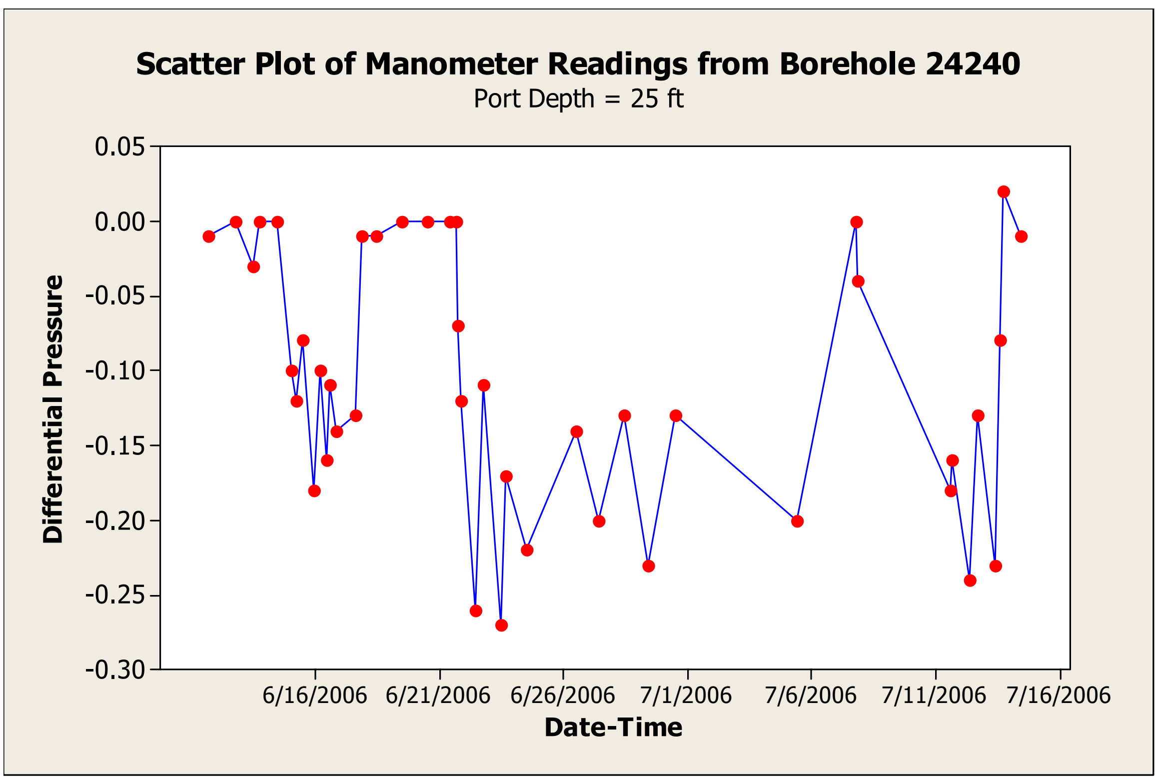

TCA Readings from Borehole 24240
LocationDepth = 54-24240 (75)
TCA
0
200
400
600
800
1000
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

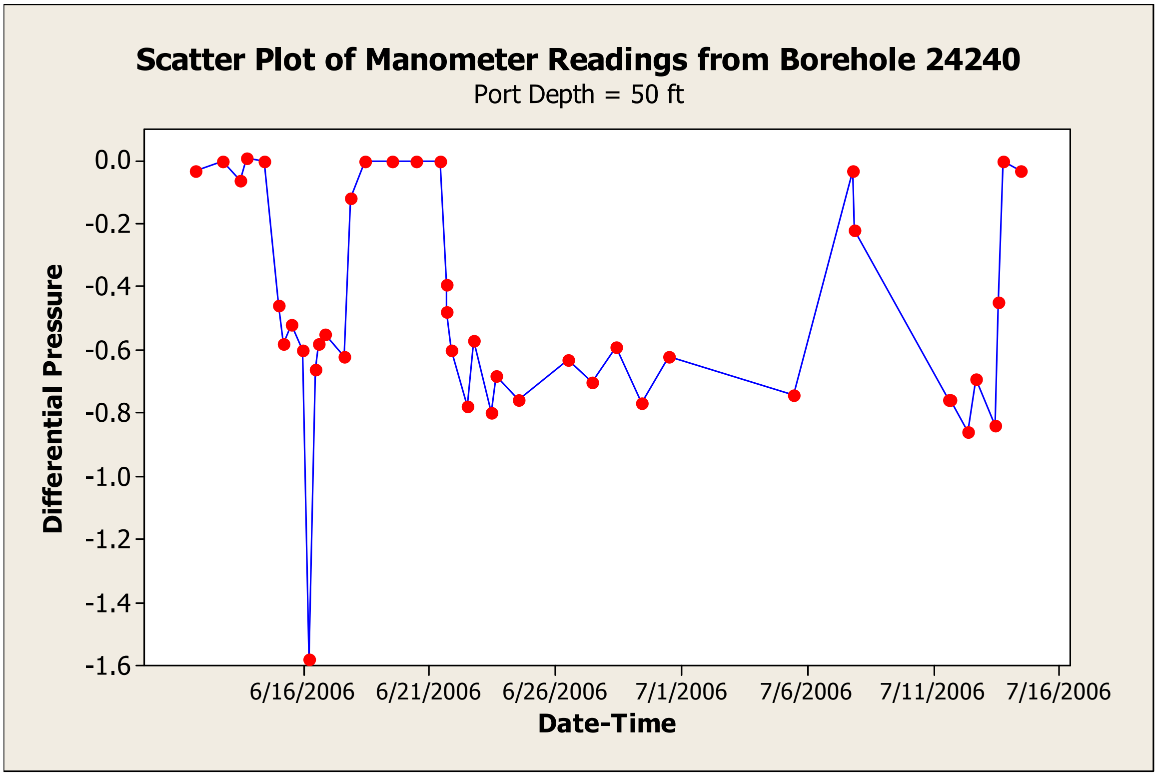

TCA Readings from Borehole 24240
LocationDepth = 54-24240 (125)
TCA
Date-Time
0
100
200
300
400
500
600
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006

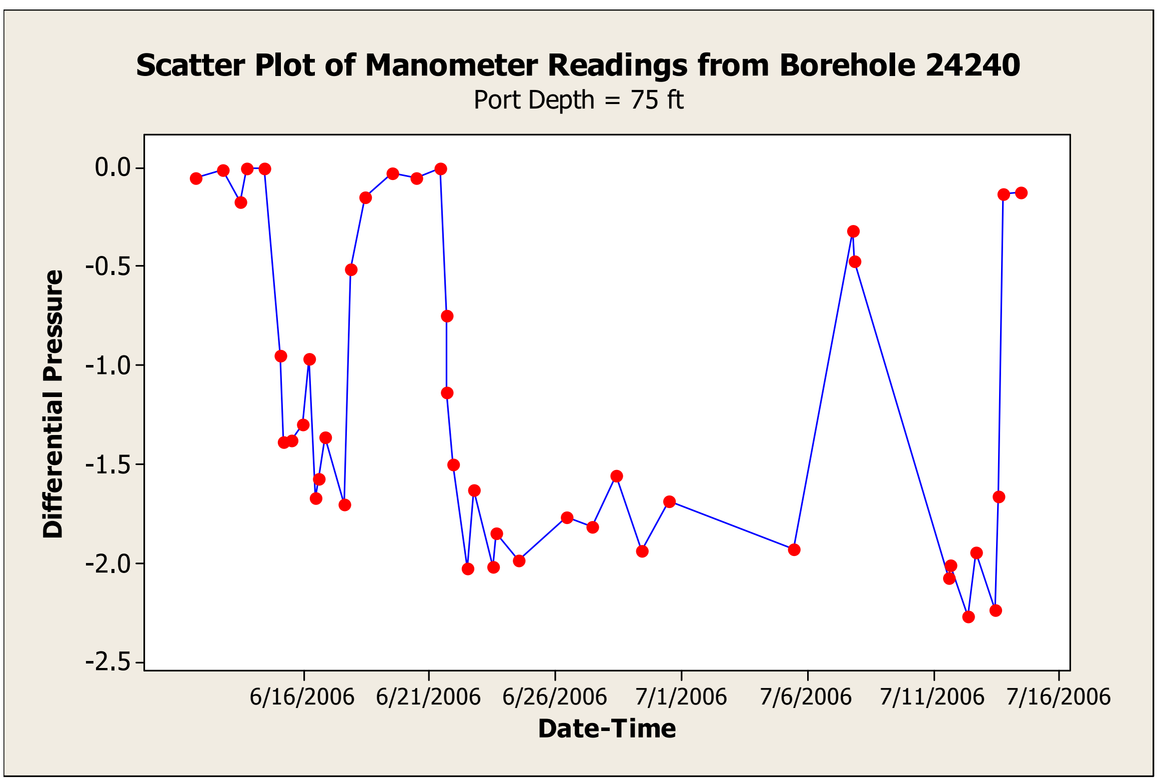

TCA Readings from Borehole 24240
LocationDepth = 54-24240 (150)
TCA
Date-Time
0
100
200
300
400
500
600
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006

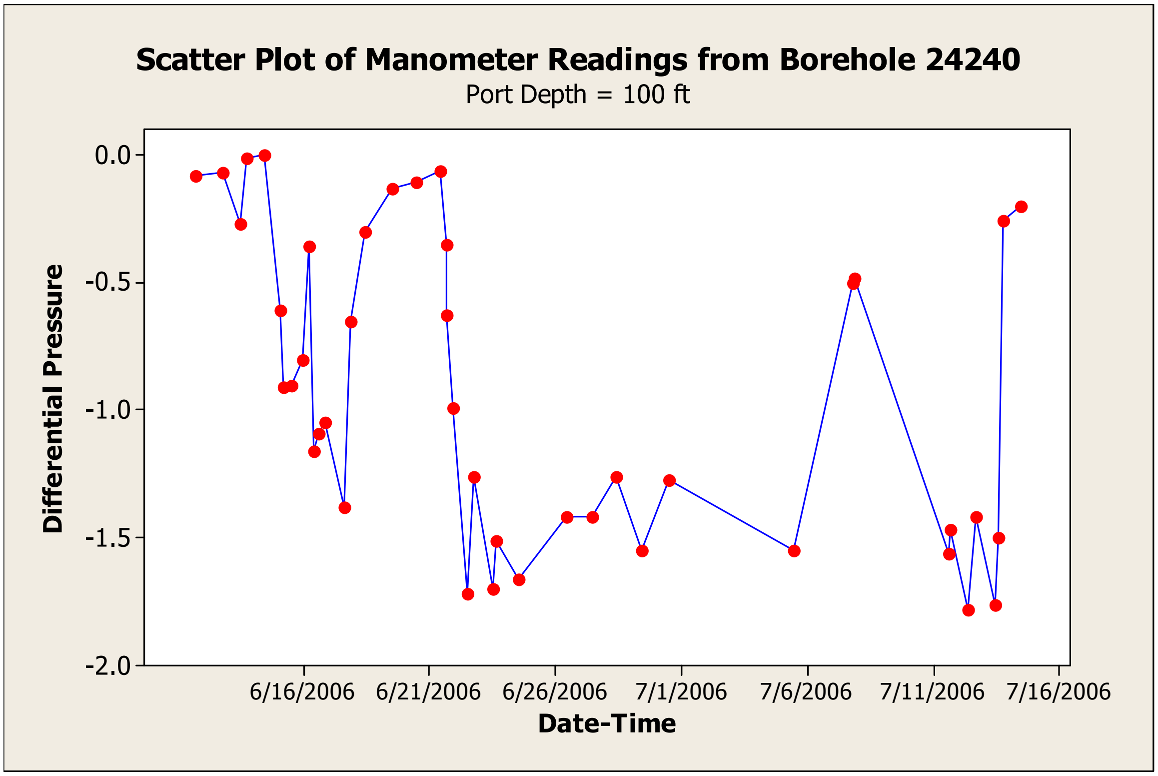
Scatter Plots of Manometer Readings from Borehole 54-24240

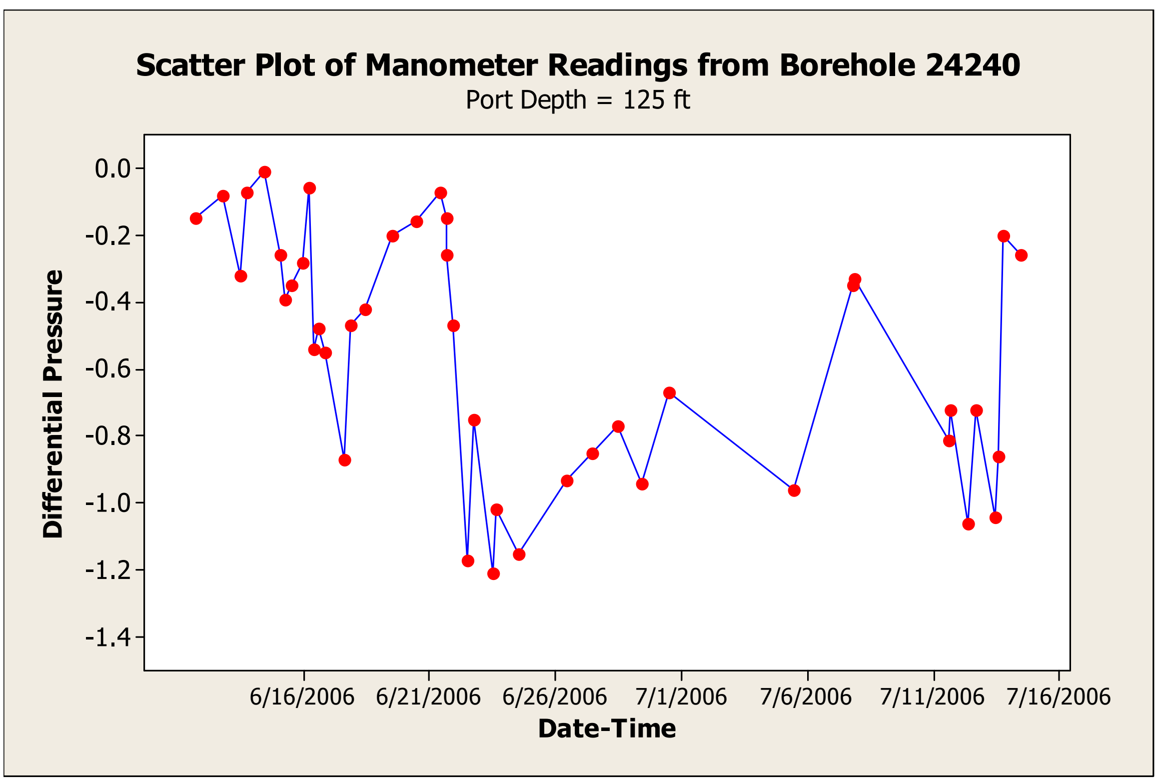


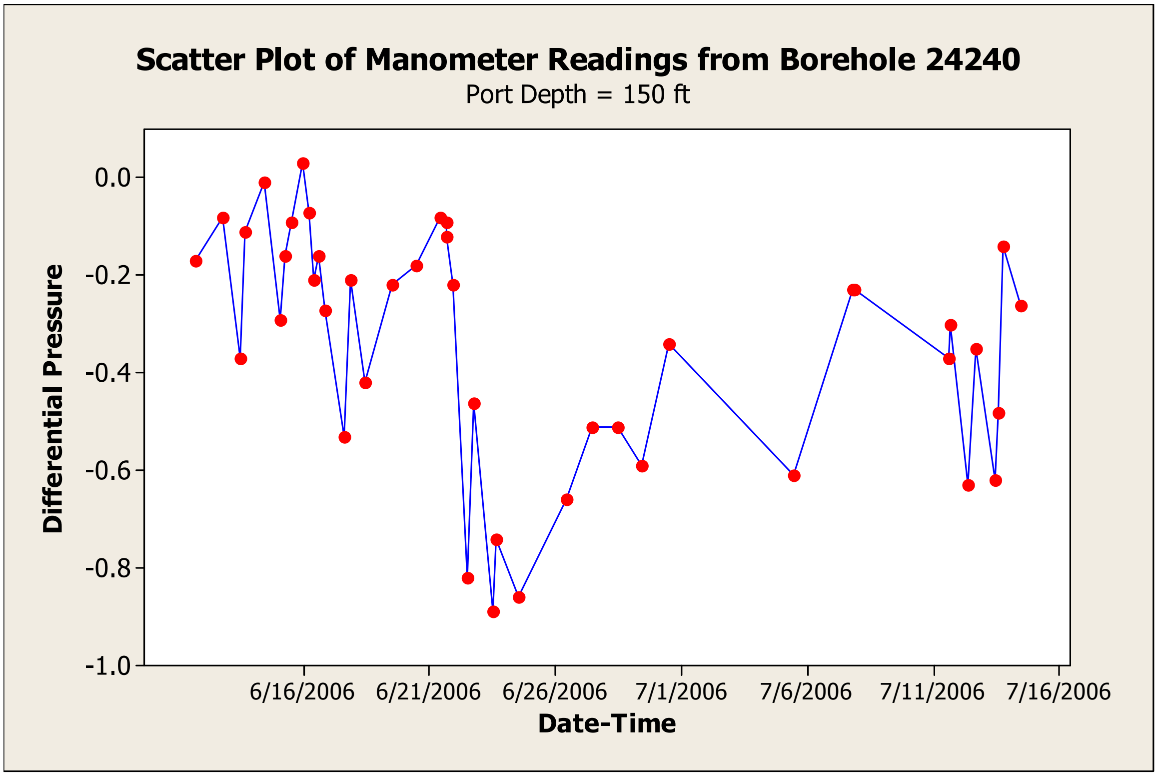



Scatter Plot of Manometer Readings from Borehole 24240
Port Depth = 50 ft
Differential Pressure
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
-1.6
6/16/2006
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

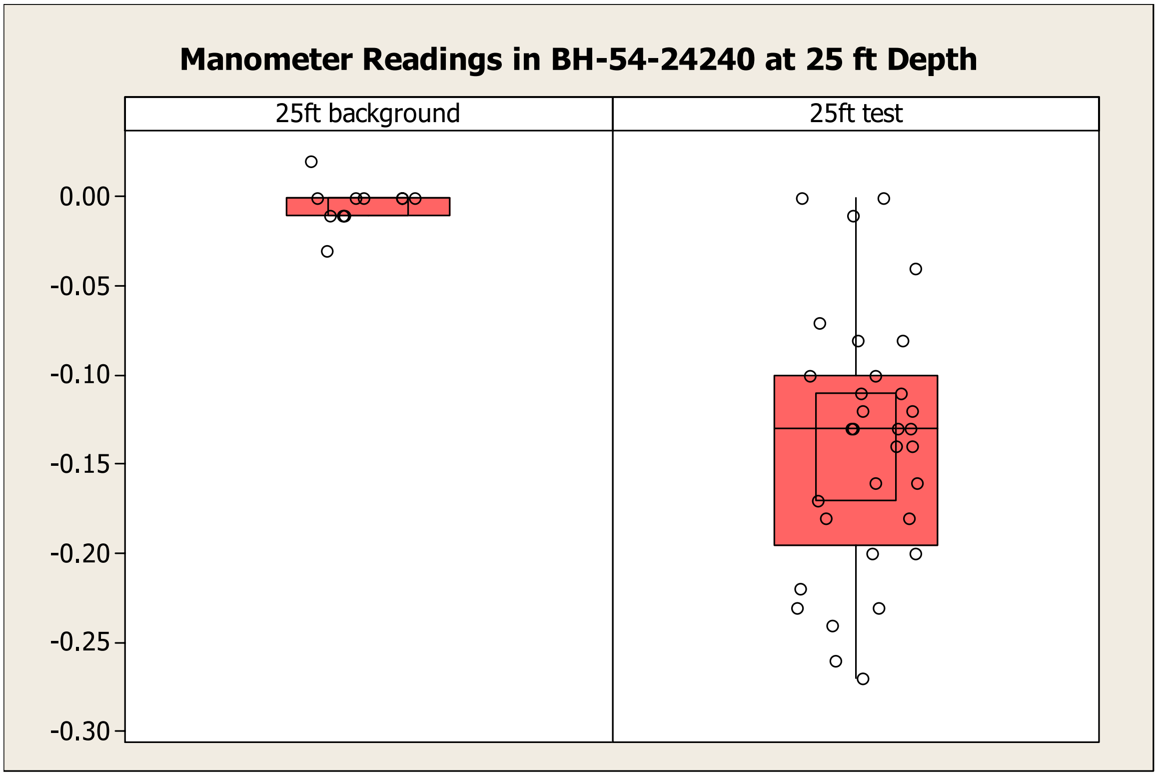

Scatter Plot of Manometer Readings from Borehole 24240
Port Depth = 75 ft
Differential Pressure
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
6/16/2006
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

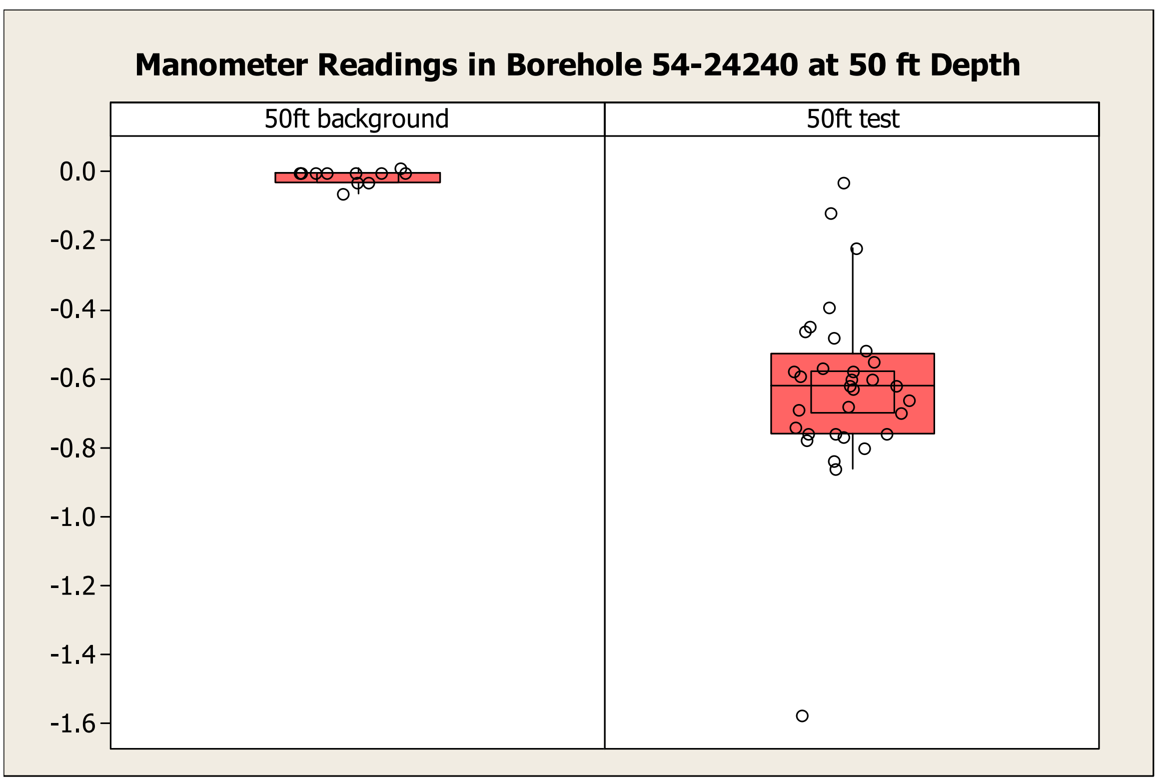

Scatter Plot of Manometer Readings from Borehole 24240
Port Depth = 100 ft
Differential Pressure
0.0
-0.5
-1.0
-1.5
-2.0
6/16/2006
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

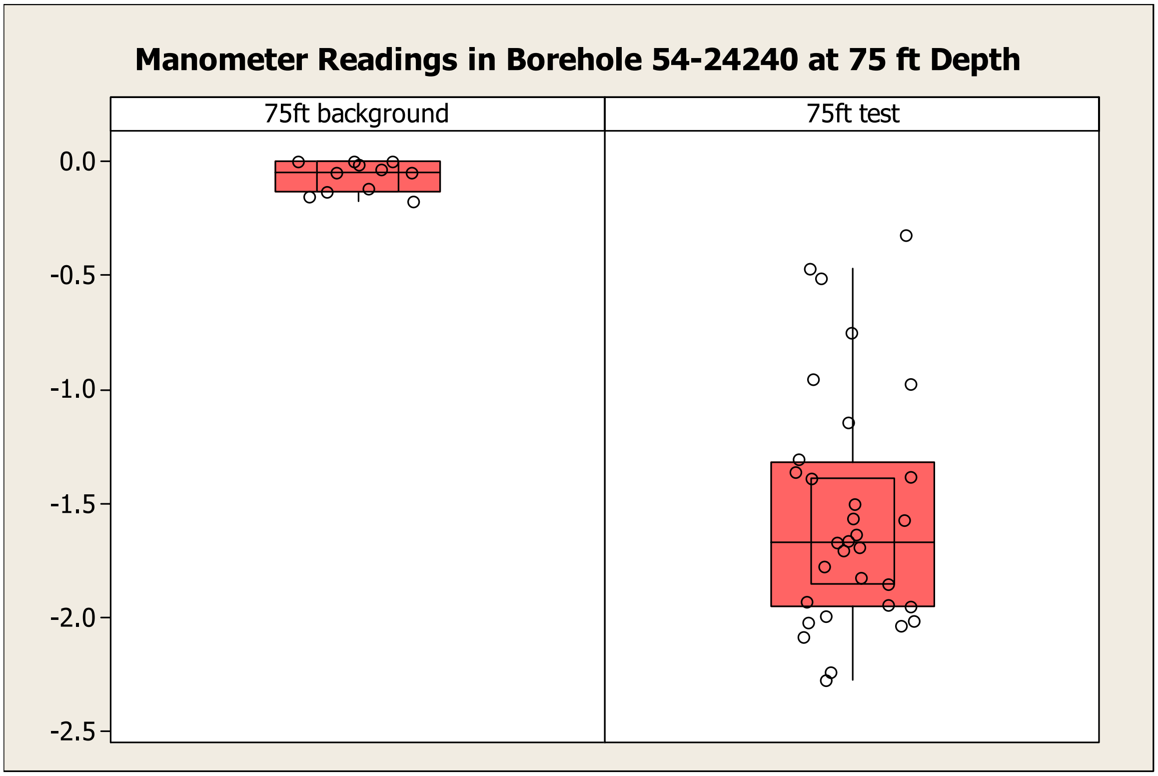

Scatter Plot of Manometer Readings from Borehole 24240
Port Depth = 125 ft
Differential Pressure
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2
-1.4
6/16/2006
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

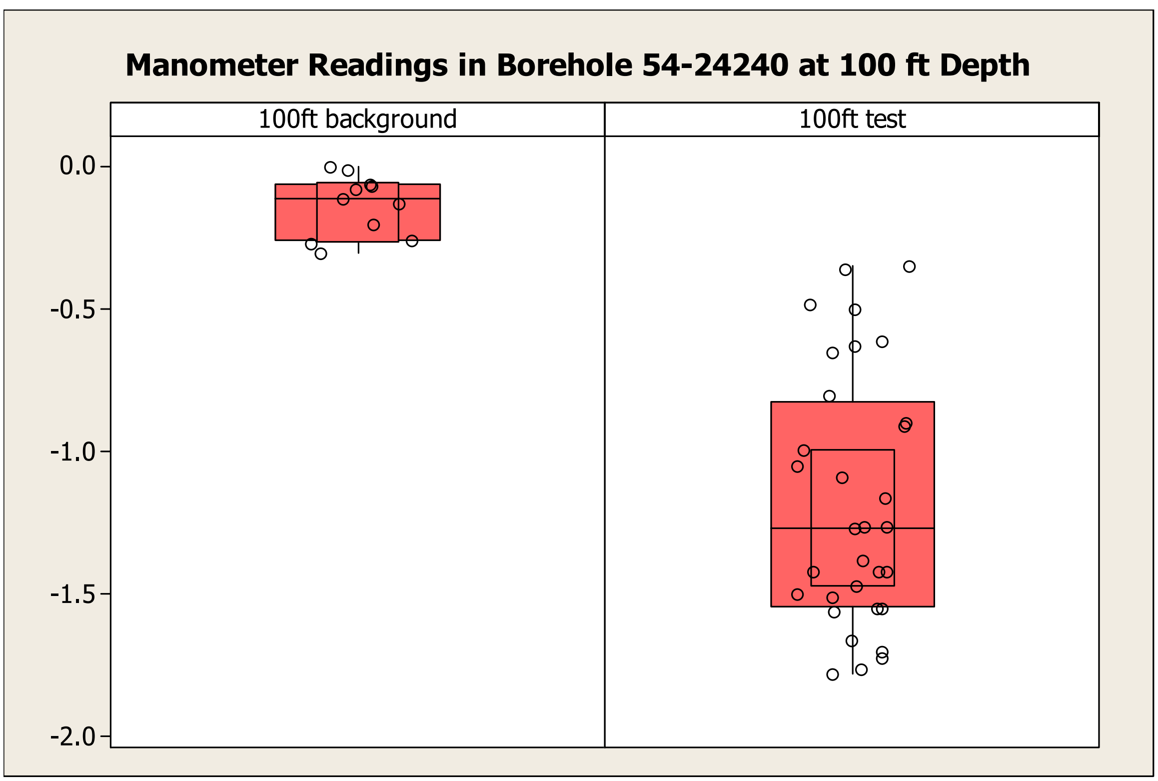

Scatter Plot of Manometer Readings from Borehole 24240
Port Depth = 150 ft
Differential Pressure
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
6/16/2006
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

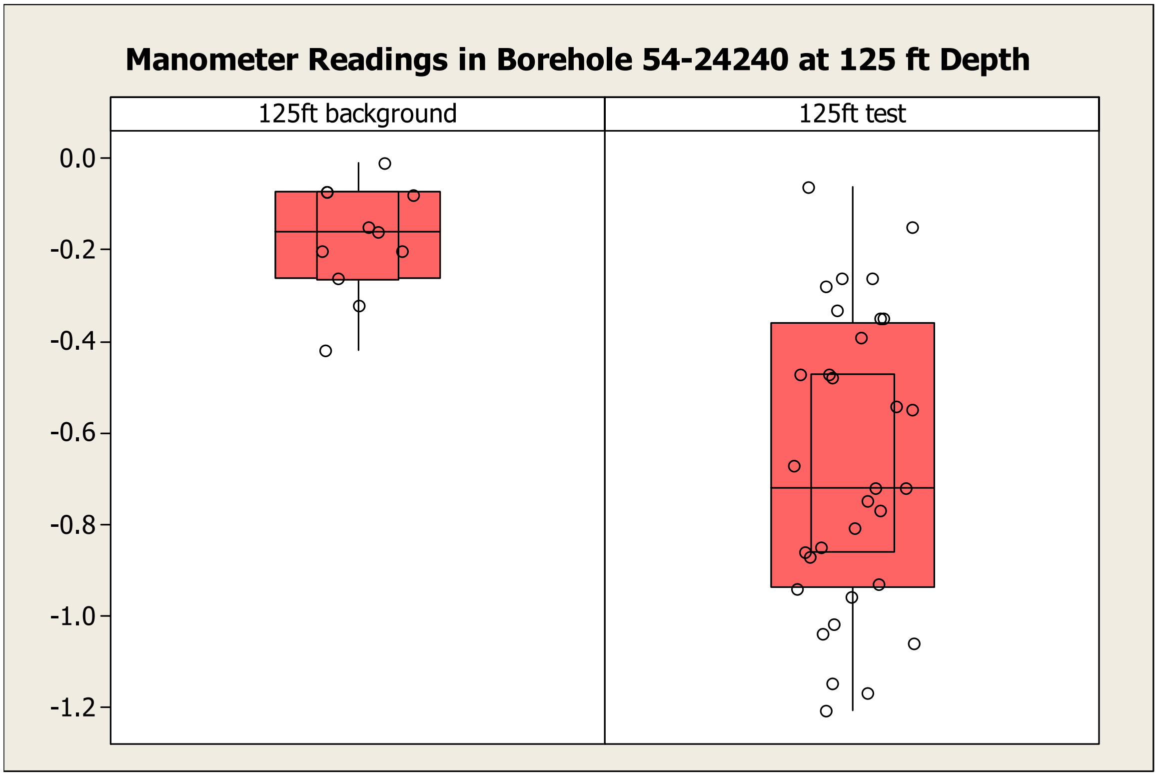
Boxplots of Manometer Readings from Borehole 54-24240

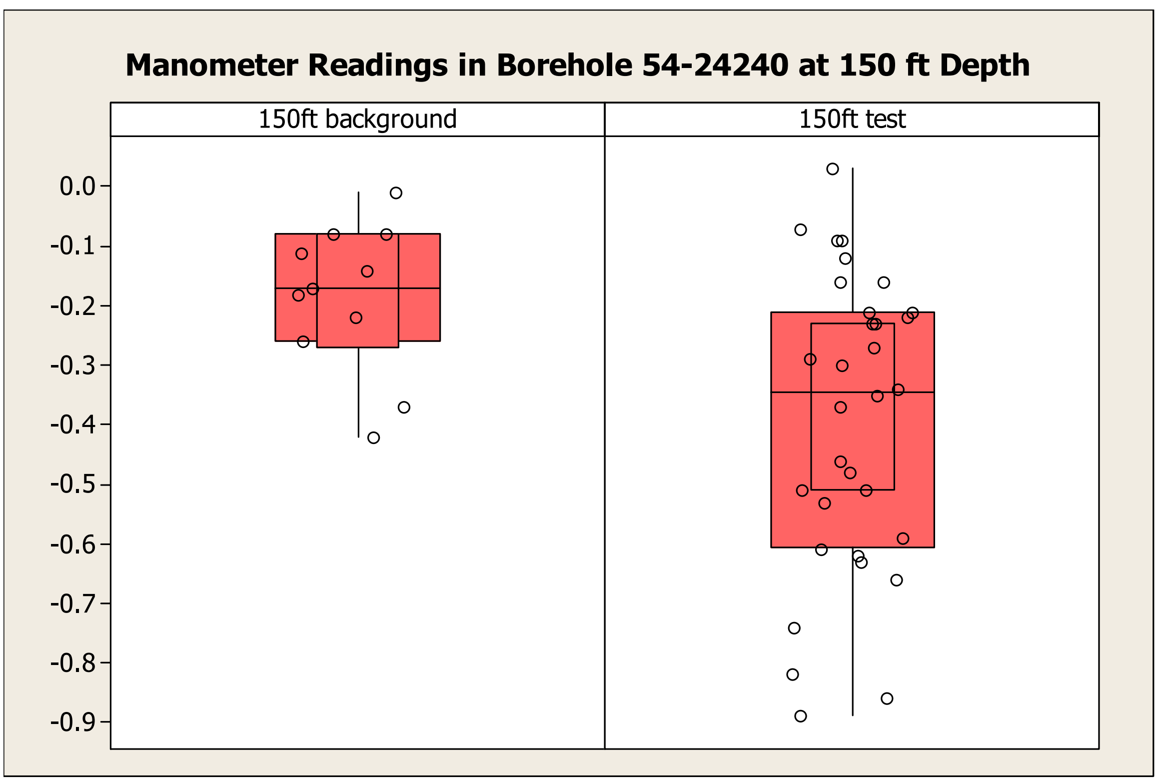




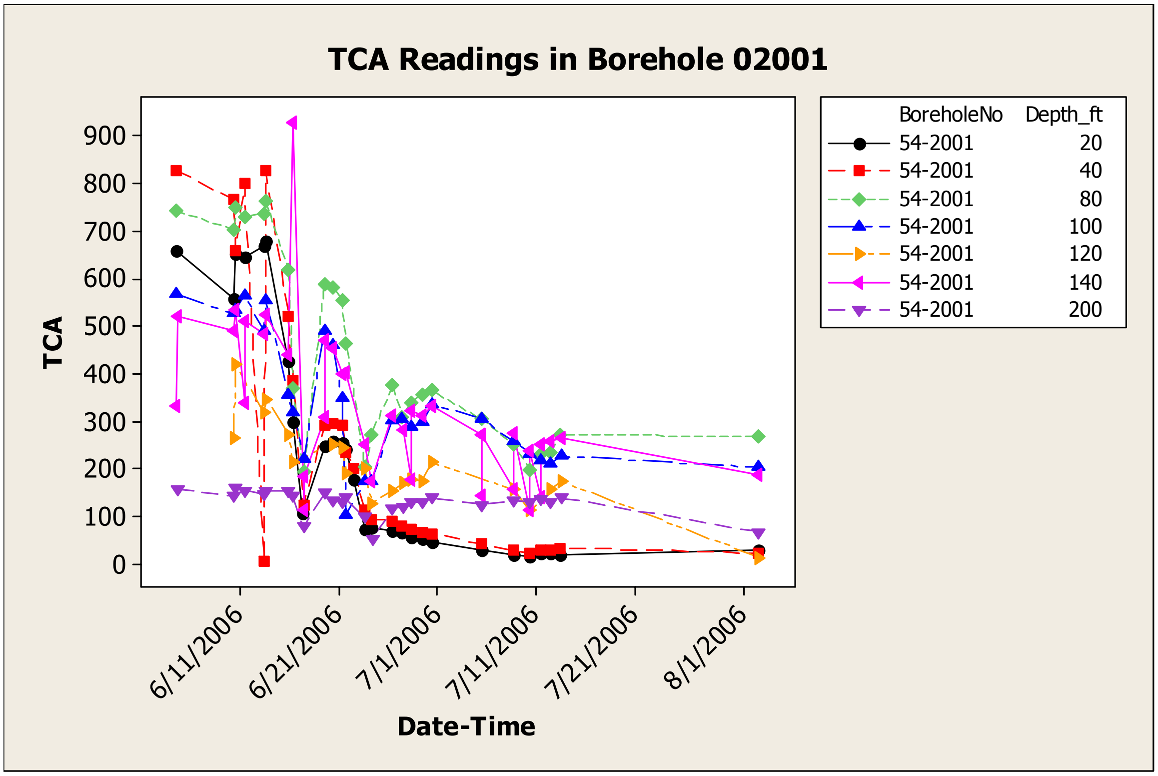

Manometer Readings in Borehole 54-24240 at 75 ft Depth
75ft background
75ft test
0.0
-0.5
-1.0
-1.5
-2.0
-2.5

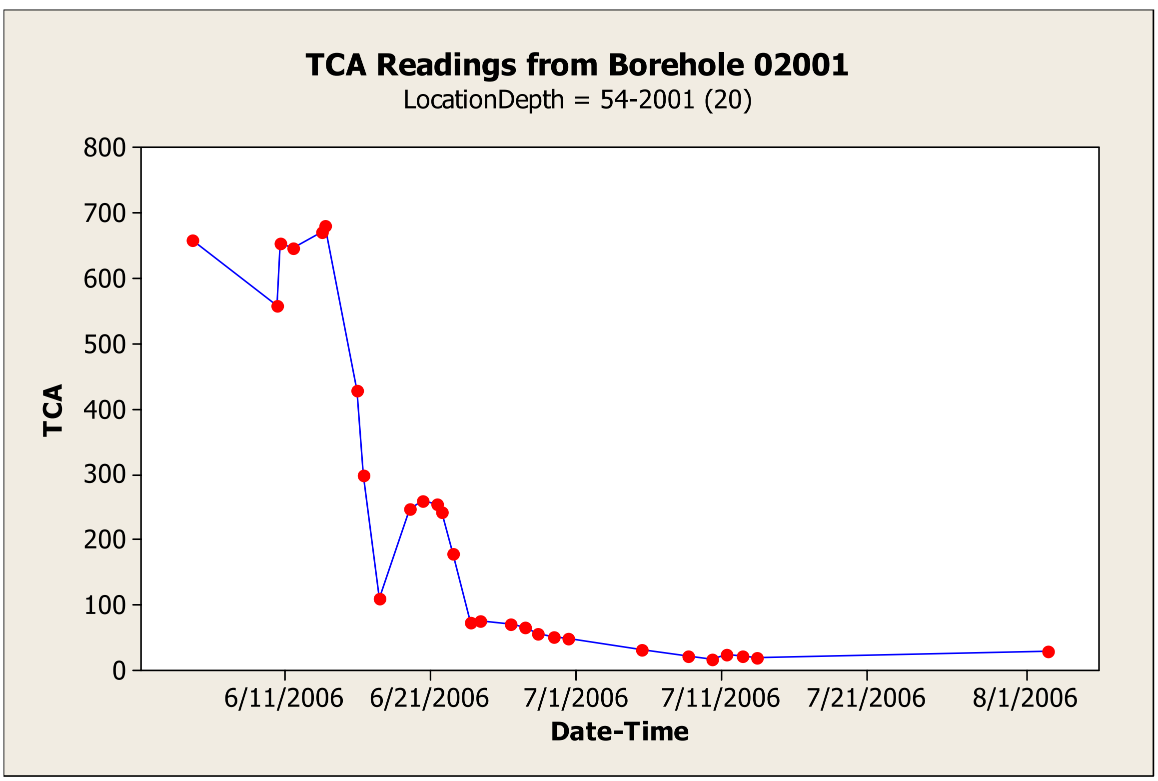

Manometer Readings in Borehole 54-24240 at 100 ft Depth
100ft background
100ft test
0.0
-0.5
-1.0
-1.5
-2.0

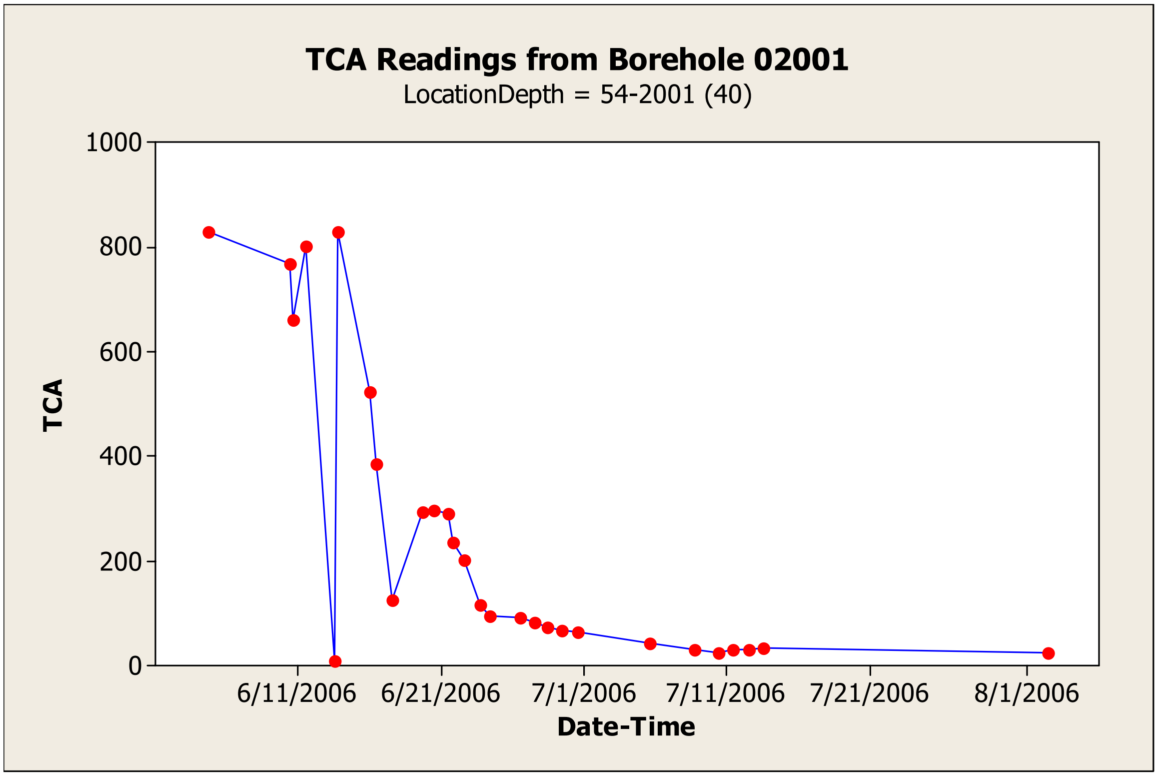

Manometer Readings in Borehole 54-24240 at 125 ft Depth
125ft background
125ft test
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
-1.2

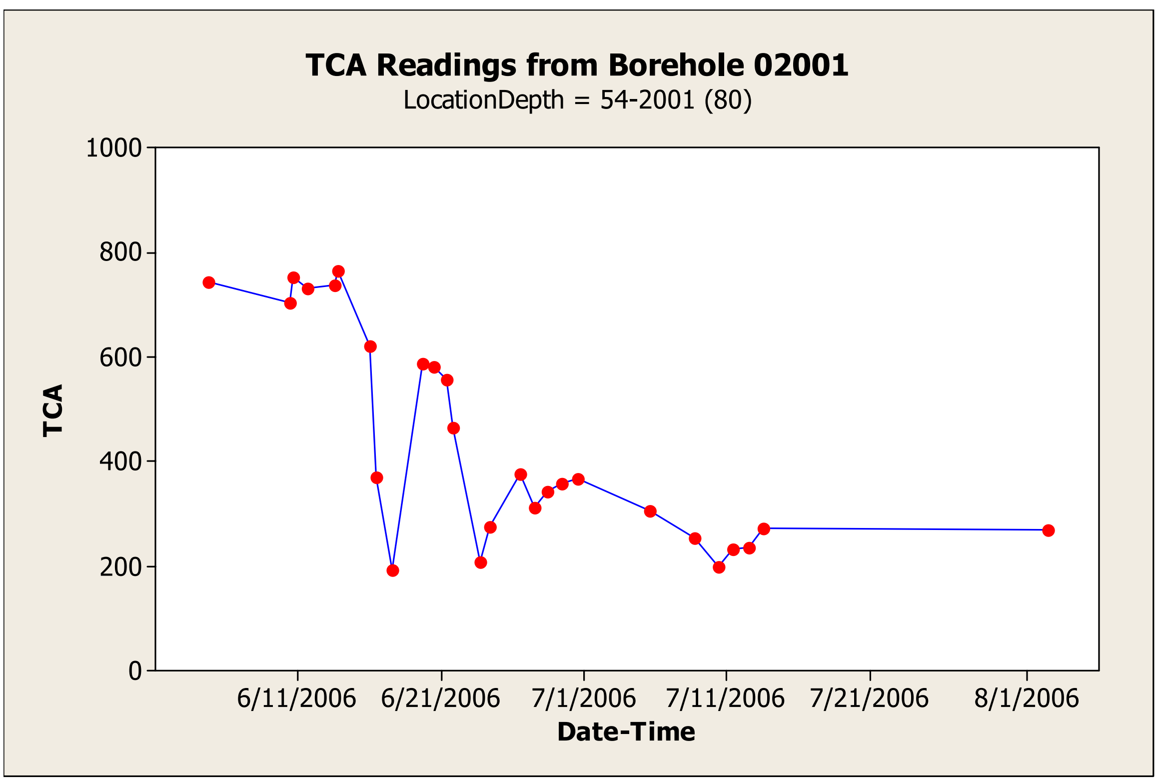

Manometer Readings in Borehole 54-24240 at 150 ft Depth
150ft background
150ft test
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
-0.9

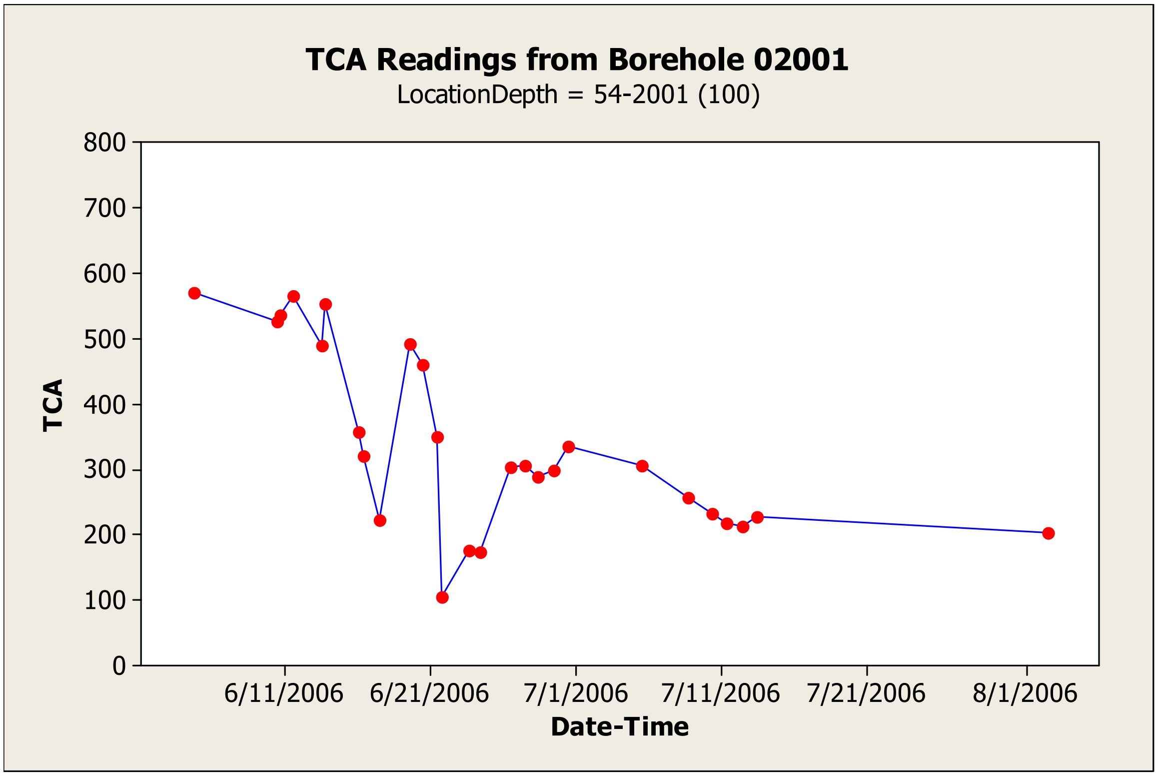
TCA B&K Readings in Borehole 54-02001

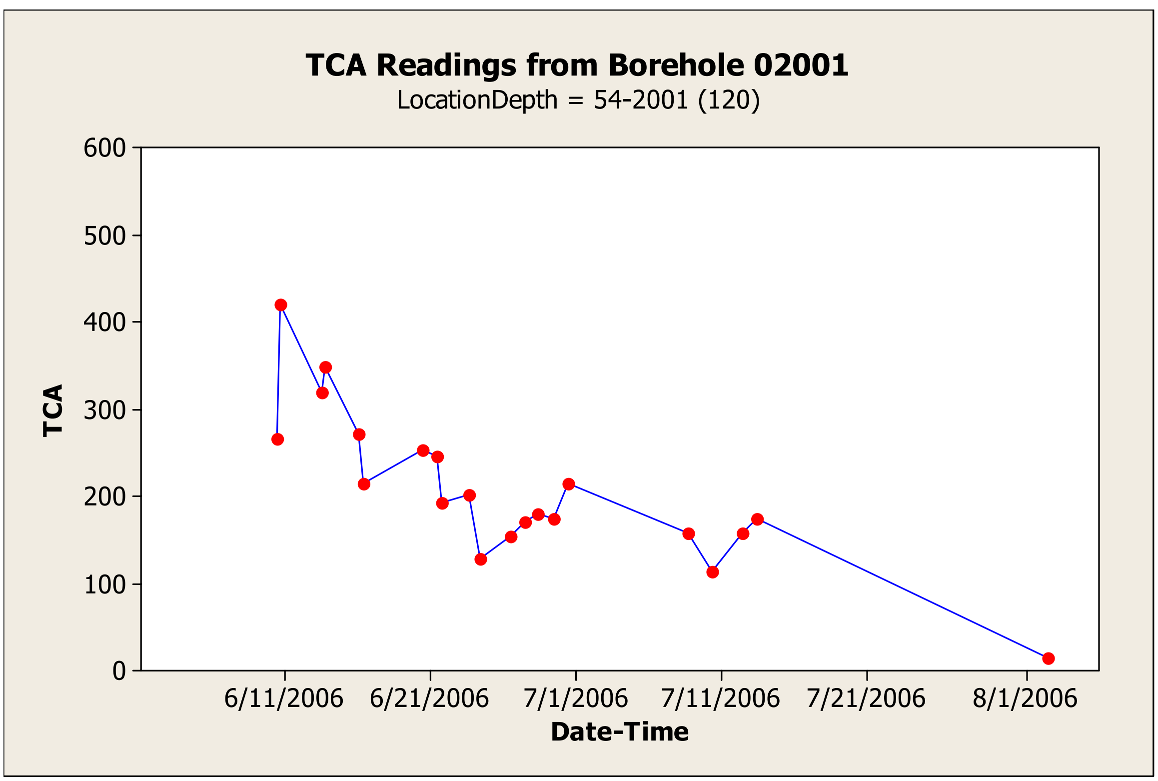


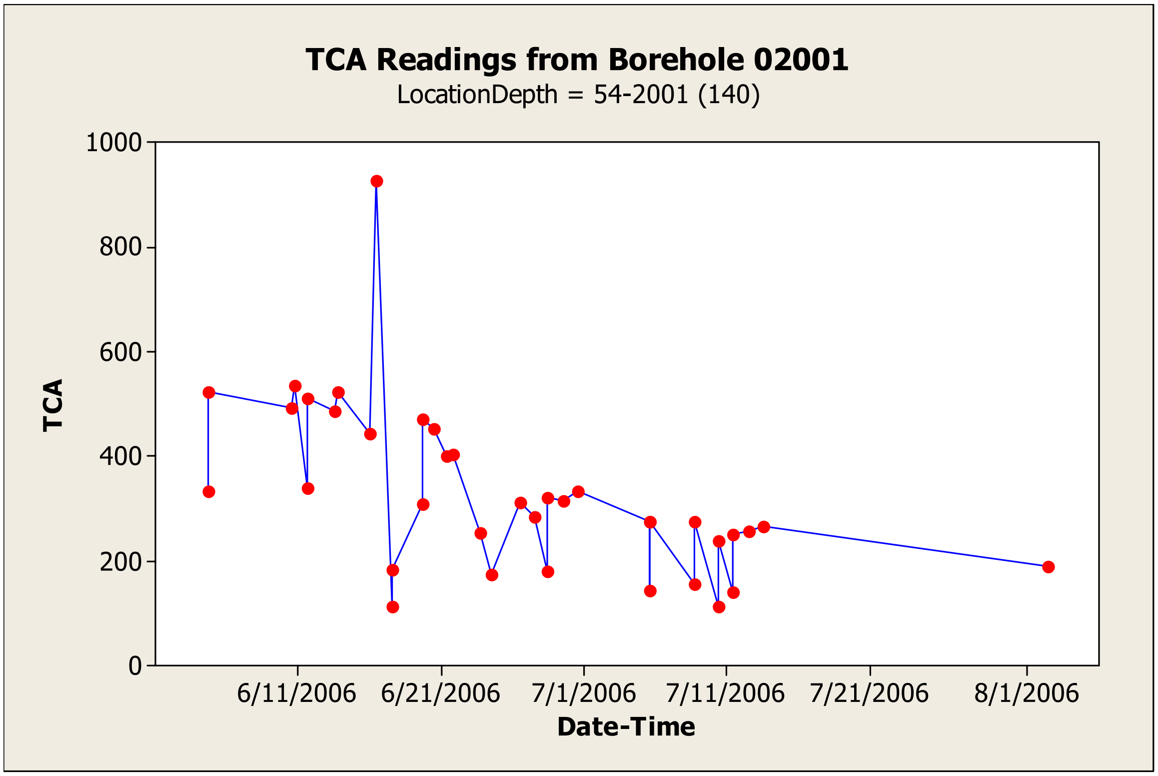


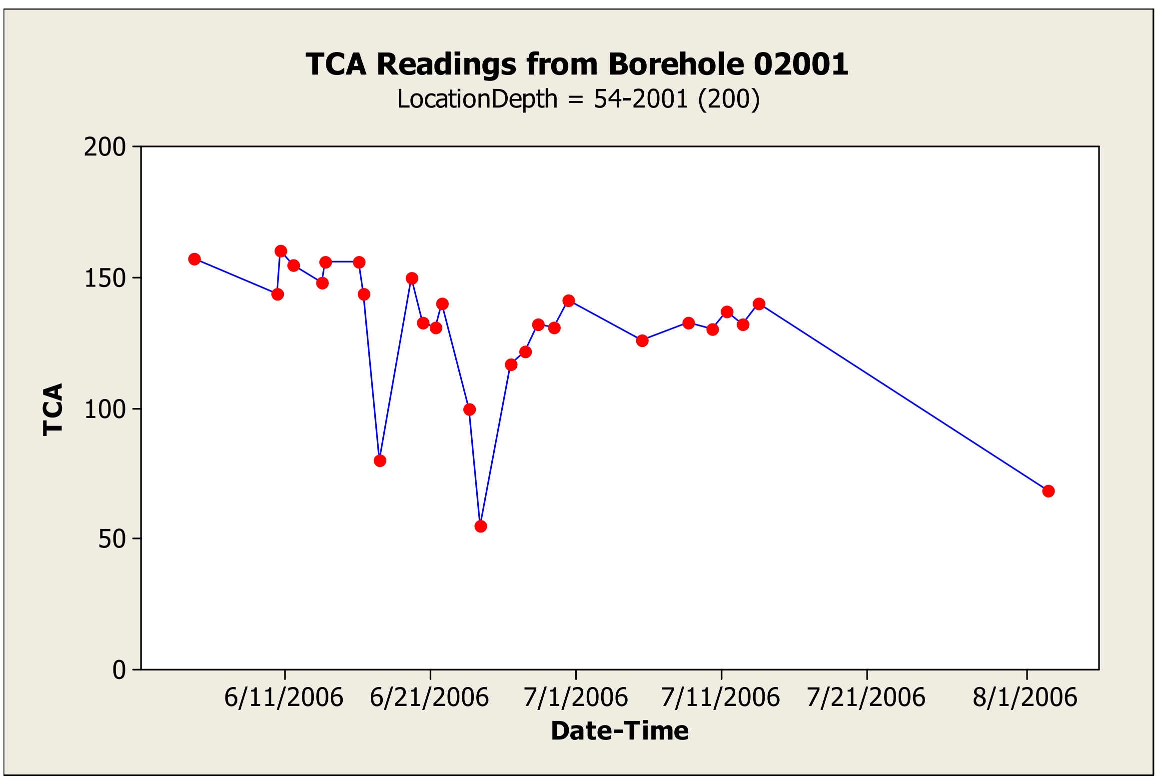

TCA Readings from Borehole 02001
LocationDepth = 54-2001 (40)
1000
800
600
400
200
0
TCA
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time


TCA Readings from Borehole 02001
LocationDepth = 54-2001 (80)
1000
800
600
400
200
0
TCA
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

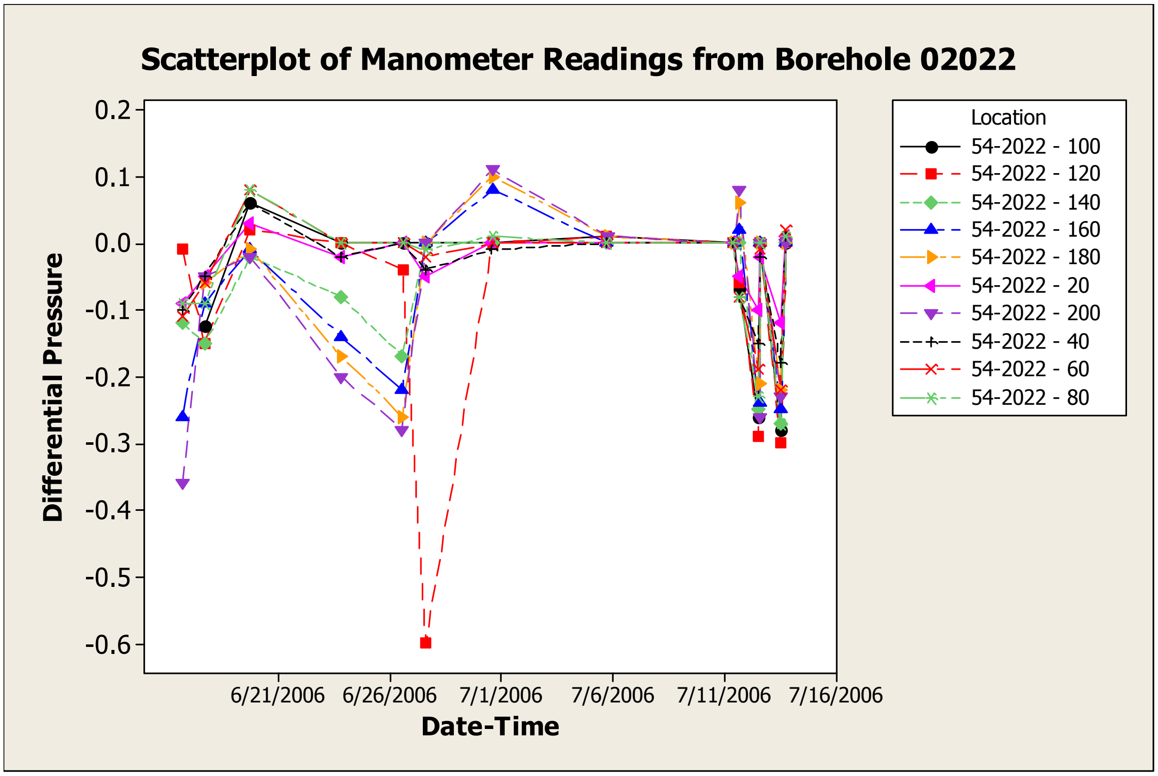

TCA Readings from Borehole 02001
LocationDepth = 54-2001 (100)
800
700
600
500
400
300
200
100
0
TCA
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

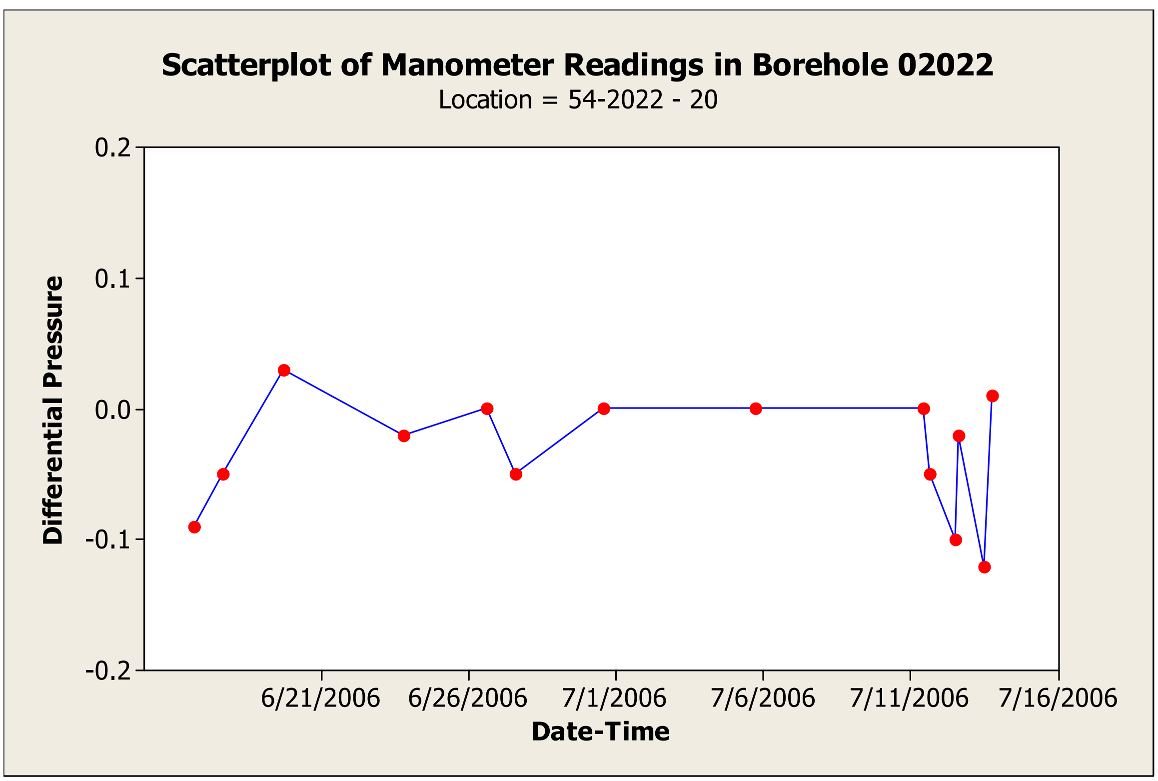

TCA Readings from Borehole 02001
LocationDepth = 54-2001 (120)
600
500
400
300
200
100
0
TCA
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

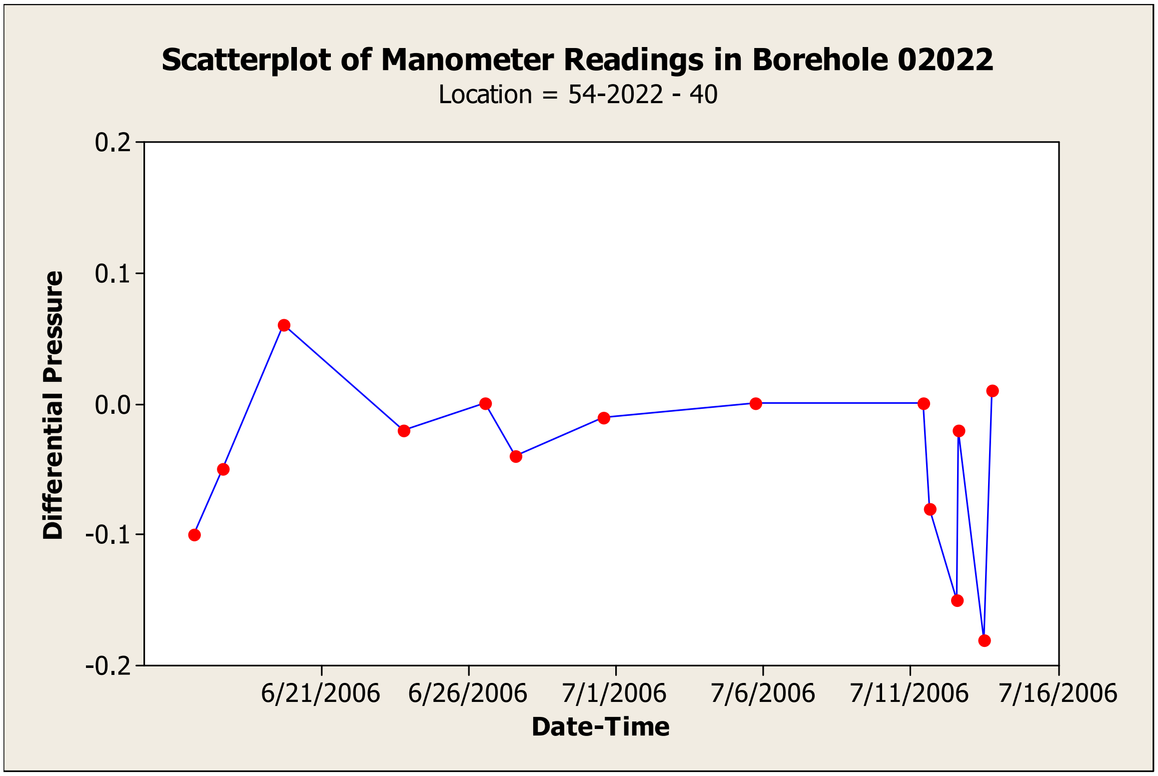

TCA Readings from Borehole 02001
LocationDepth = 54-2001 (140)
TCA
0
200
400
600
800
1000
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

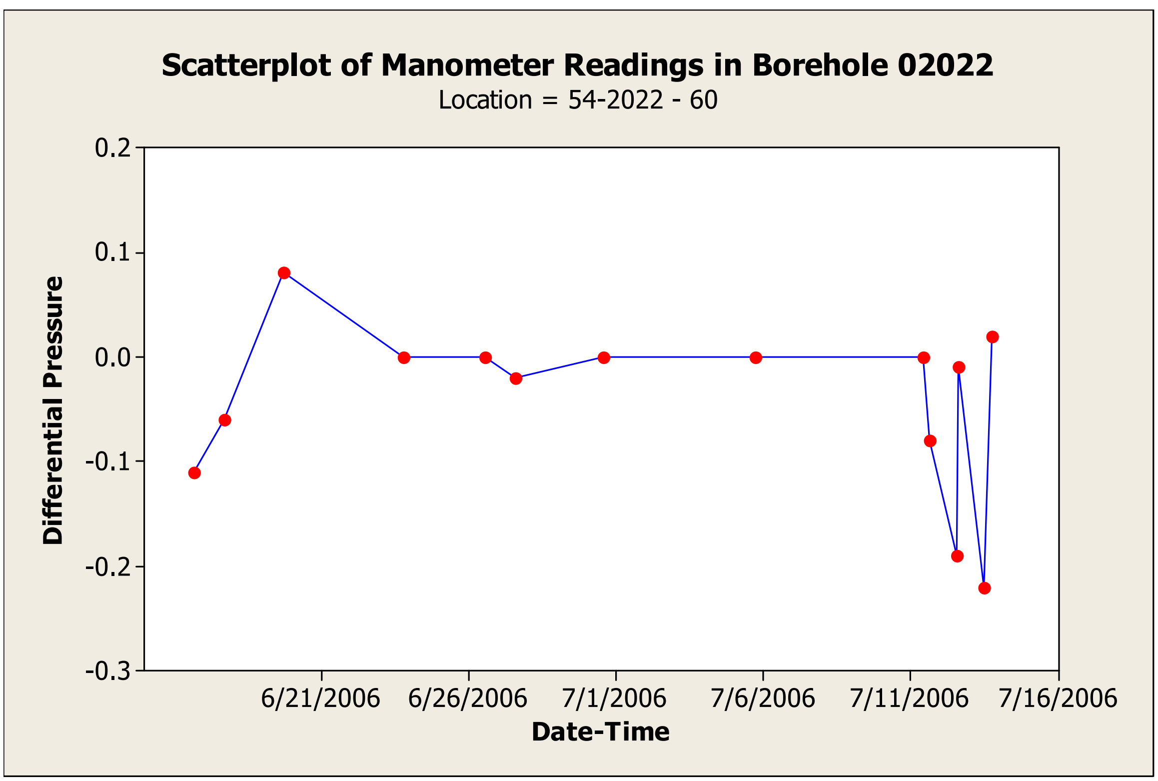

TCA Readings from Borehole 02001
LocationDepth = 54-2001 (200)
TCA
0
50
100
150
200
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time

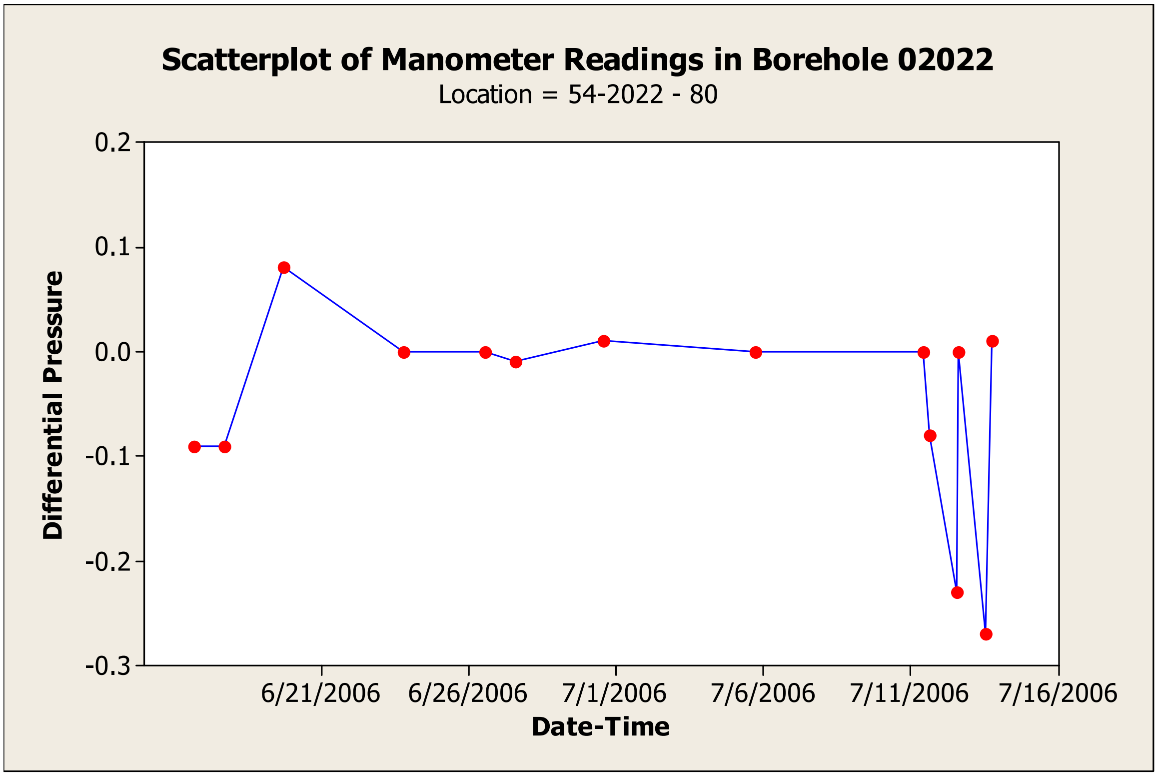
Scatterplots of Manometer Readings from Borehole 54-02022

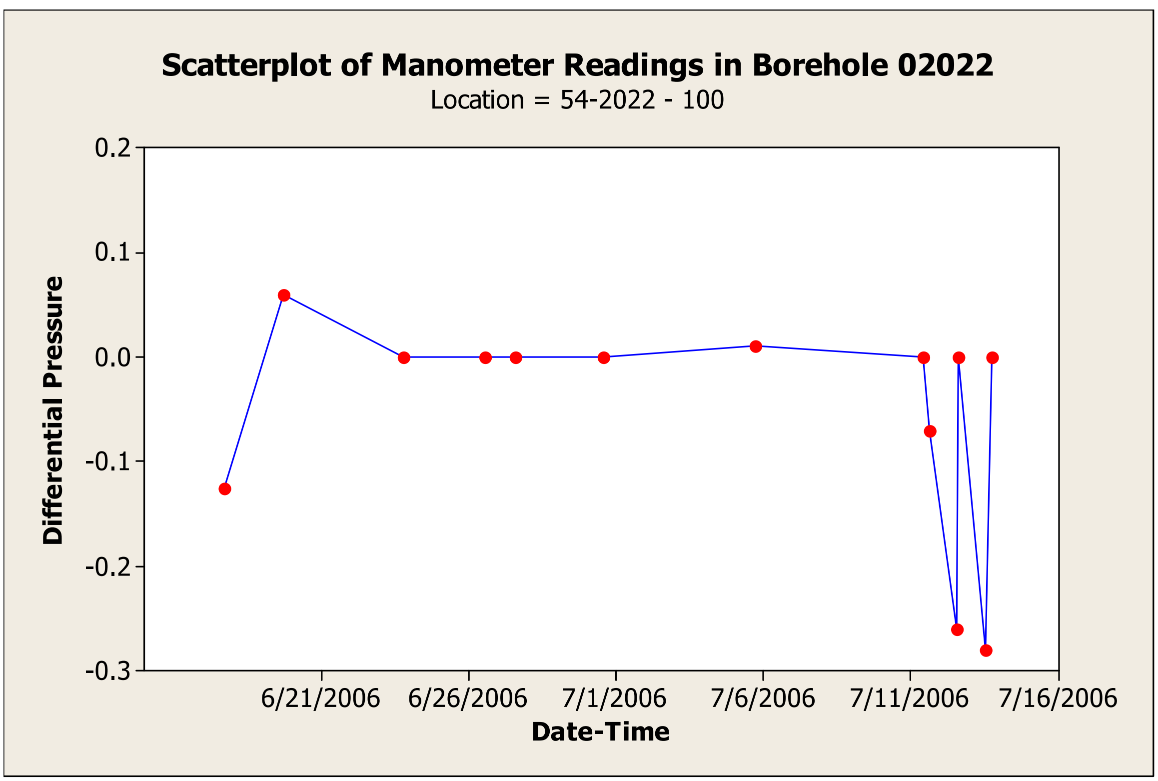


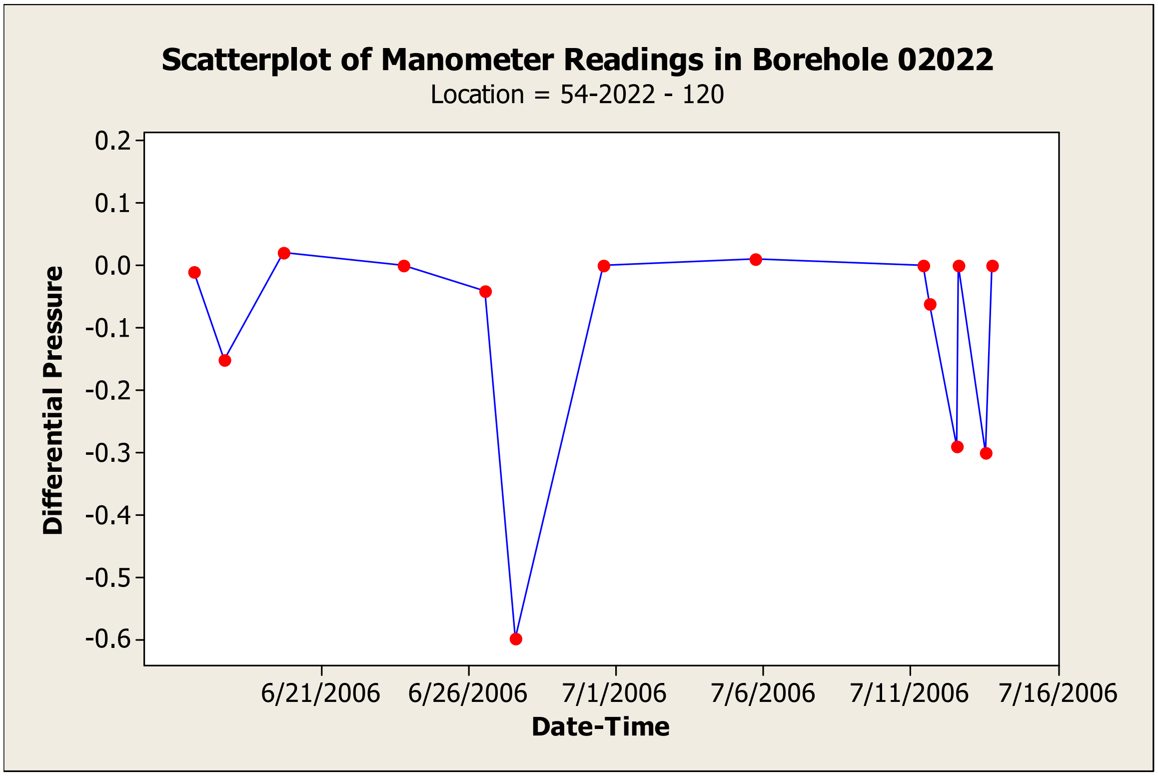


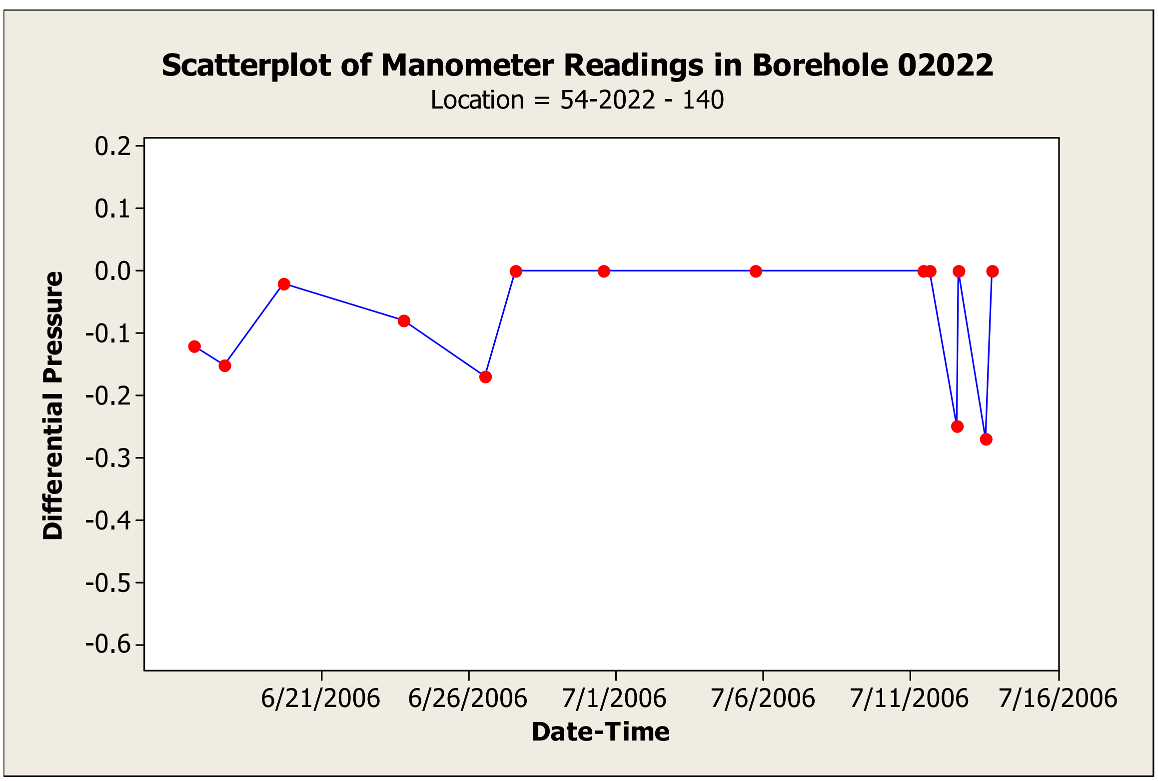

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 40
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

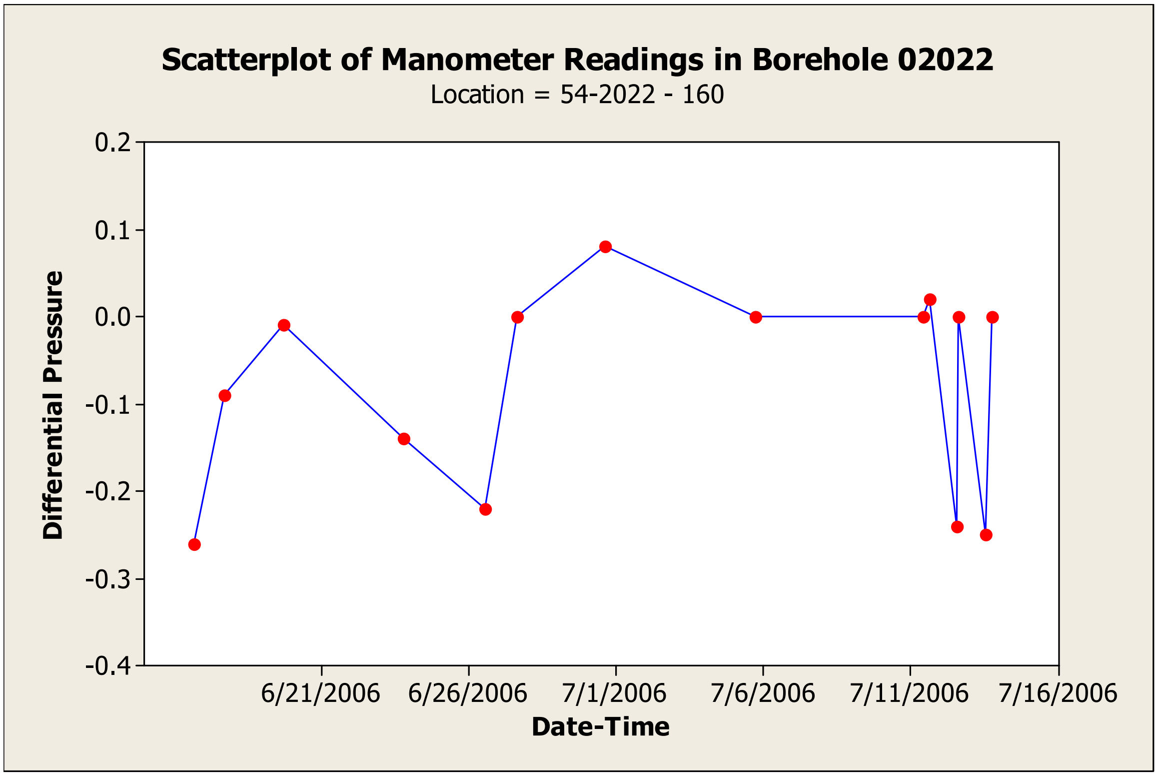

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 60
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

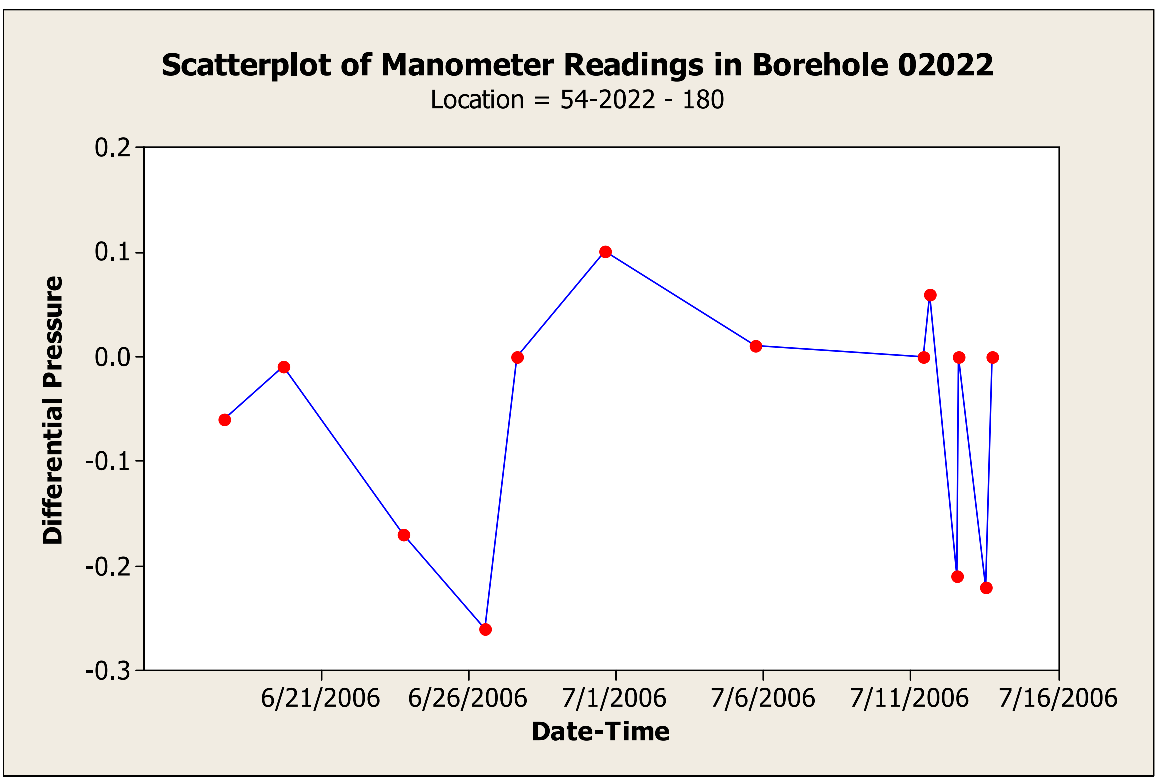

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 80
0.2
0.1
0.0
-0.1
-0.2
-0.3
Differential Pressure
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

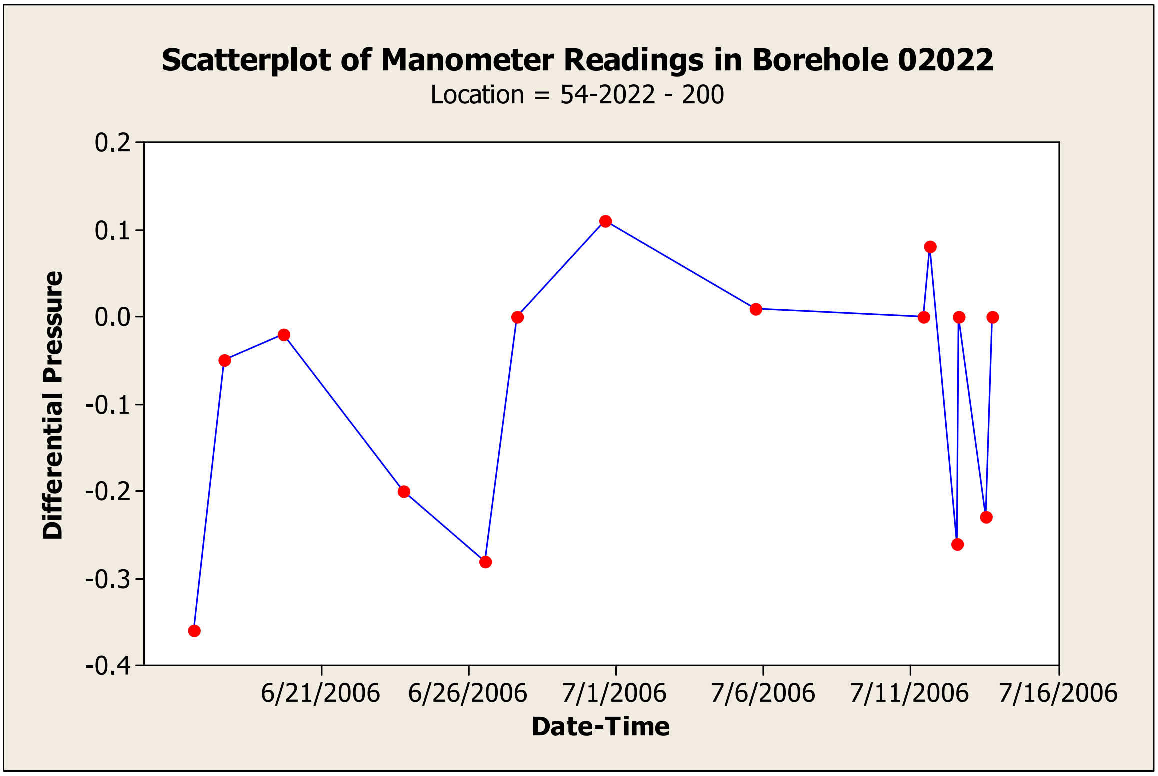

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 100
0.2
0.1
0.0
-0.1
-0.2
-0.3
Differential Pressure
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time


Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 120
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

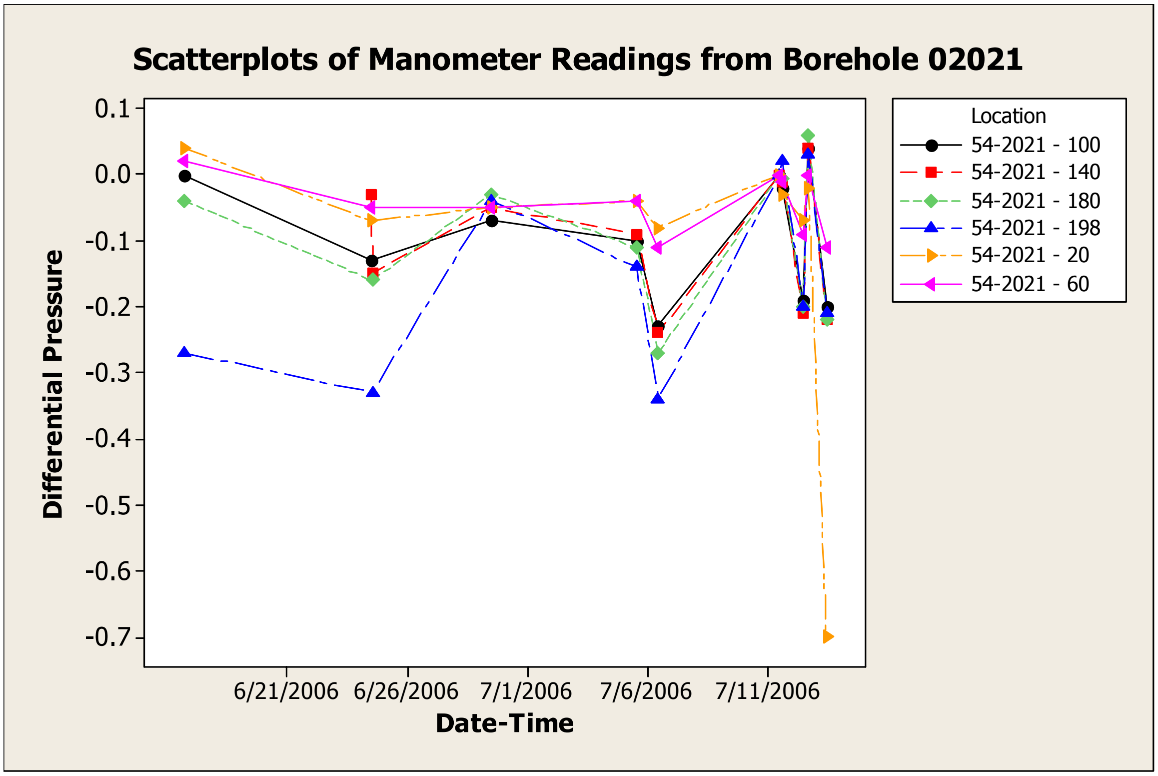

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 140
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

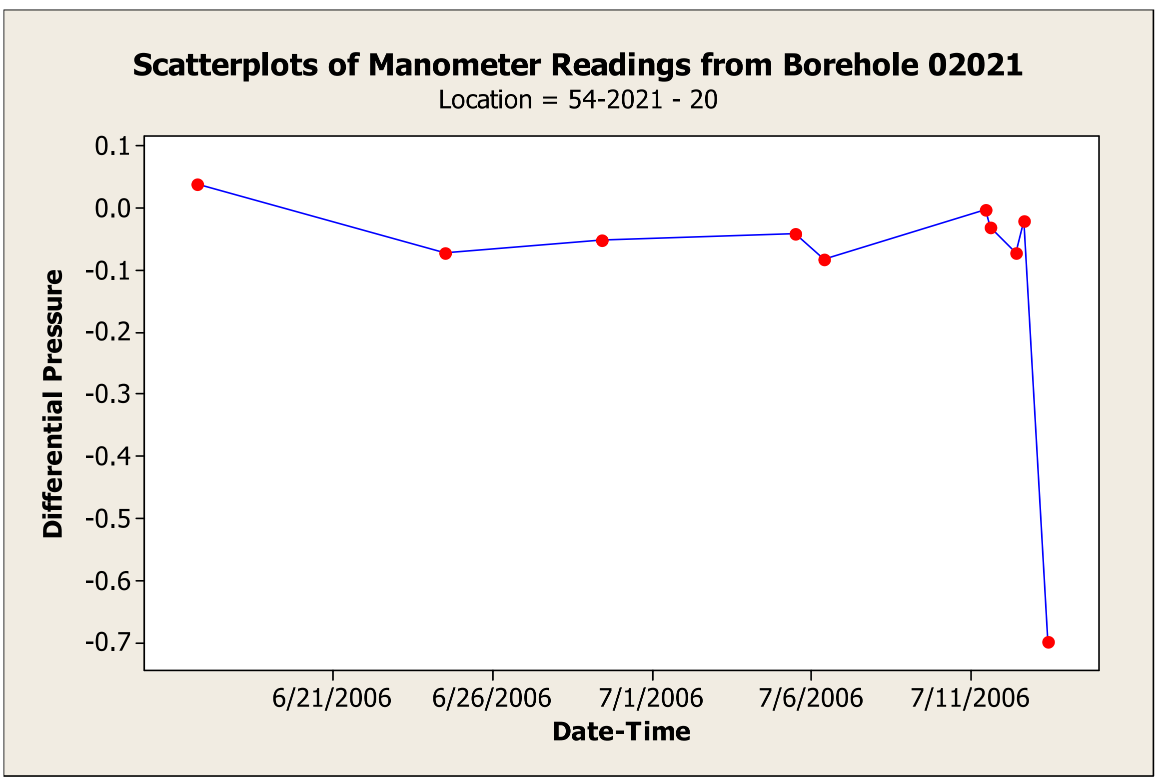

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 160
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

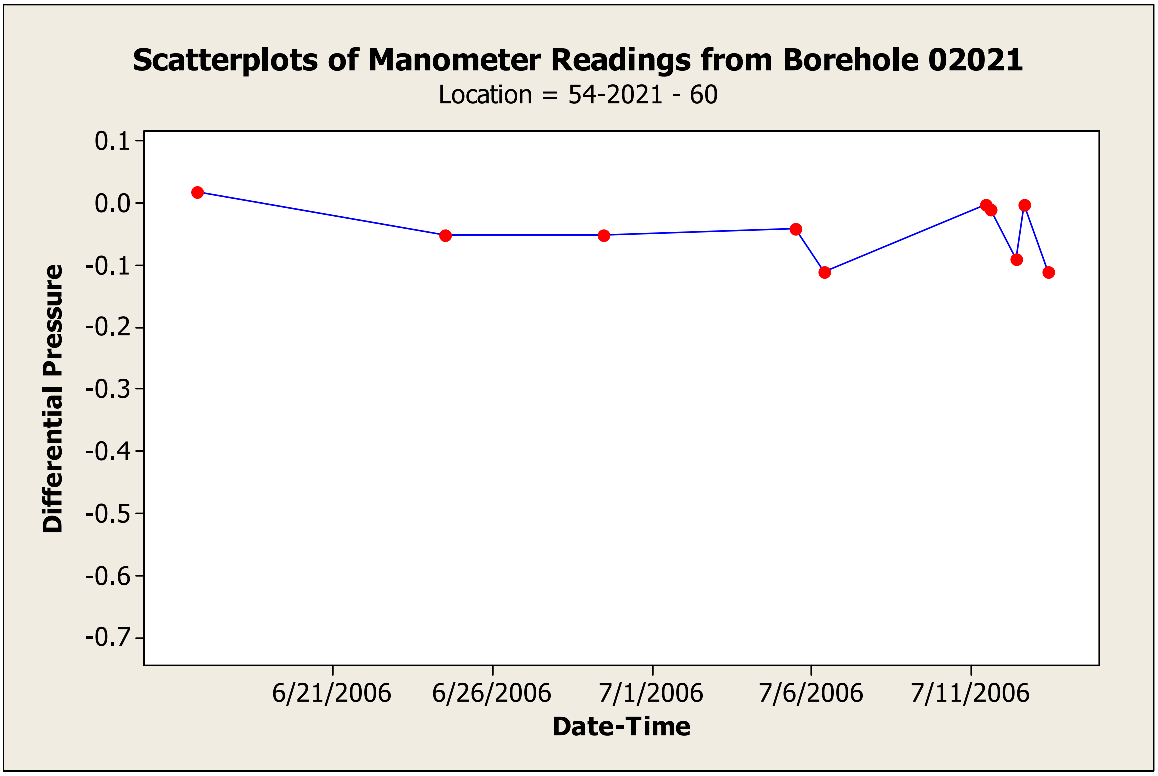

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 180
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

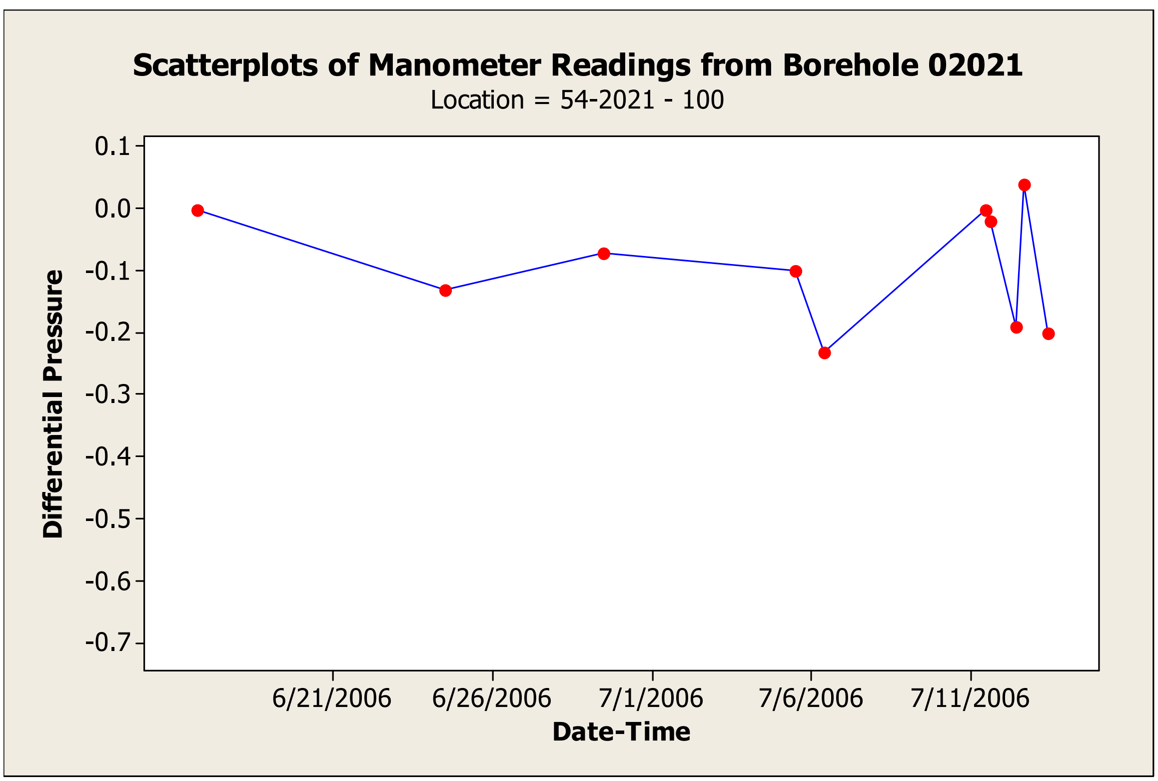

Scatterplot of Manometer Readings in Borehole 02022
Location = 54-2022 - 200
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
7/16/2006
Date-Time

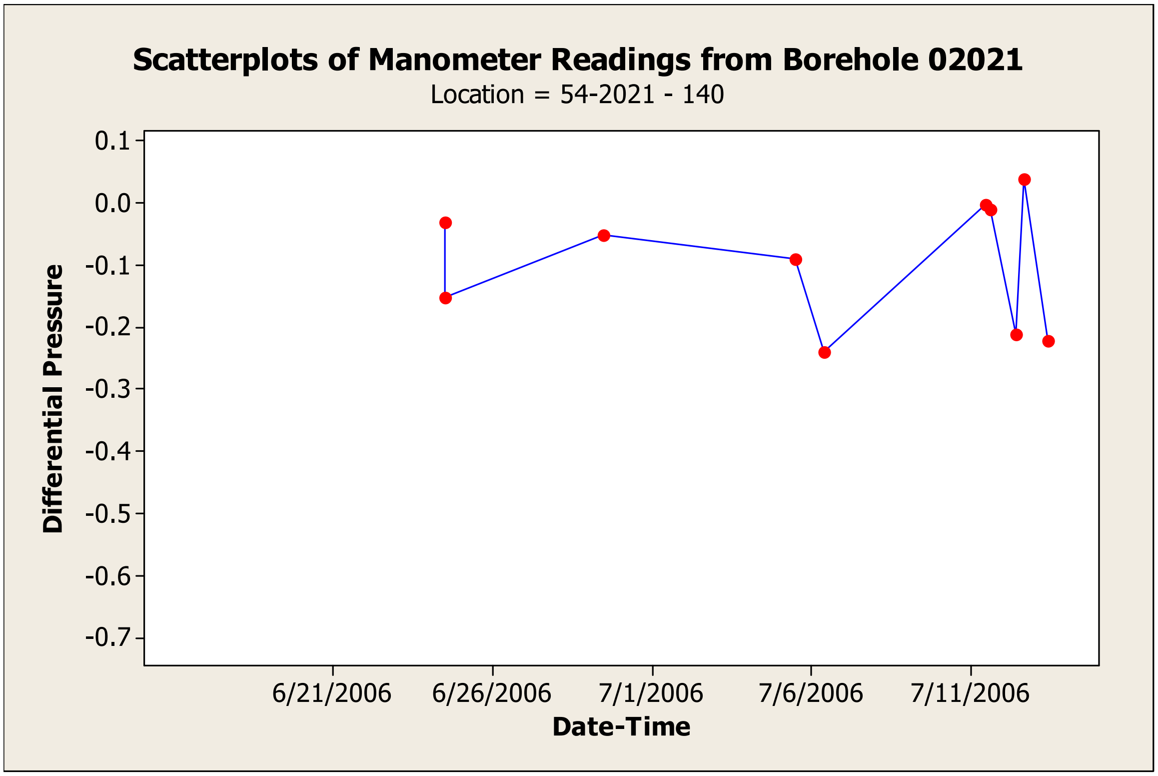
Manometer Readings from Borehole 54-02021

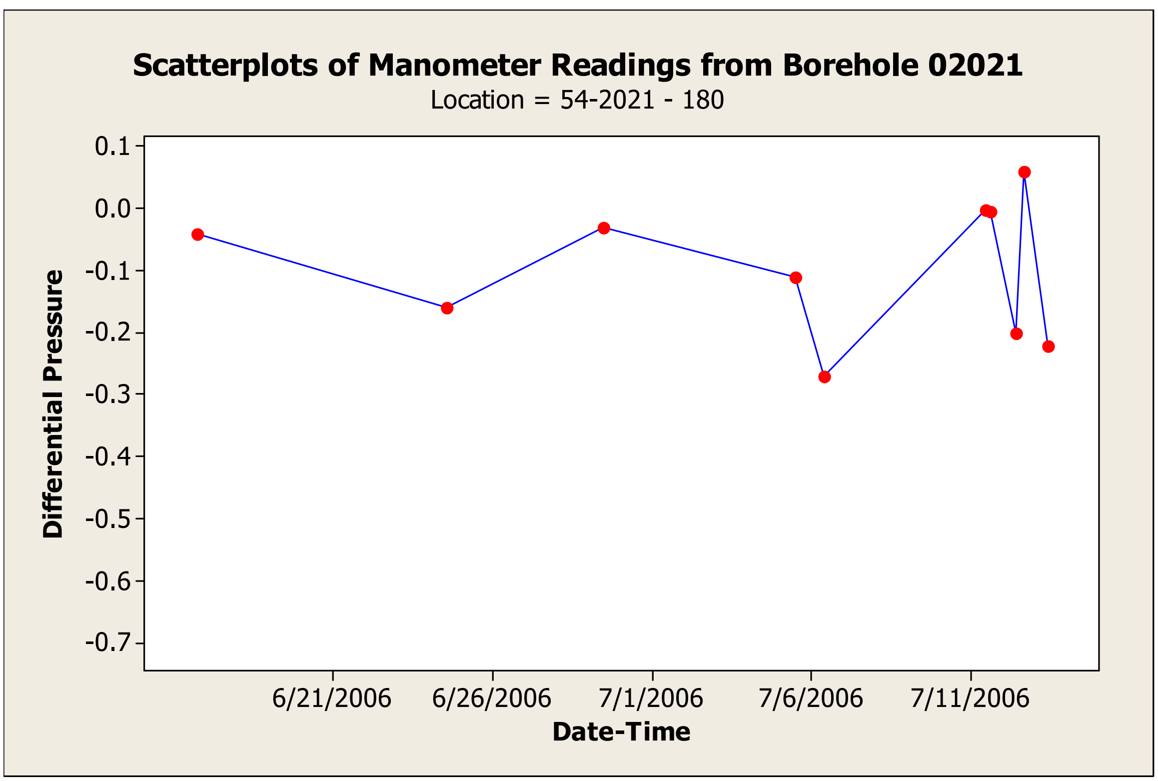


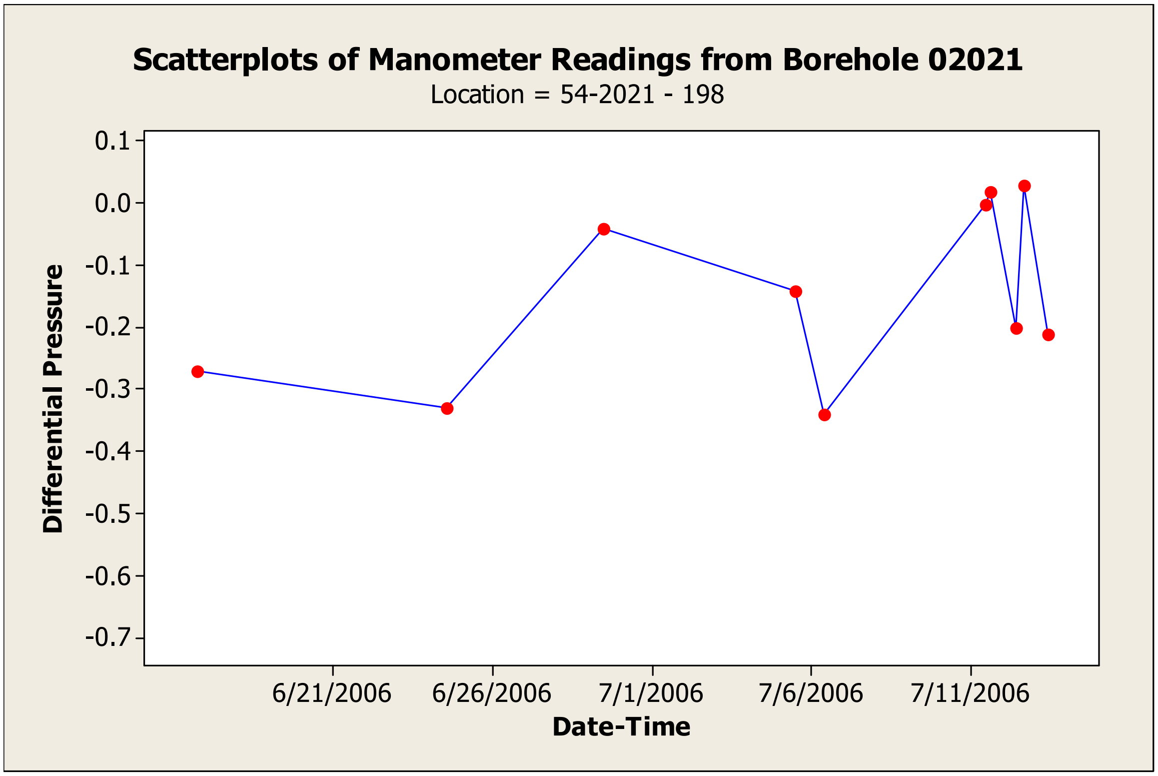



Scatterplots of Manometer Readings from Borehole 02021
Location = 54-2021 - 60
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
Date-Time

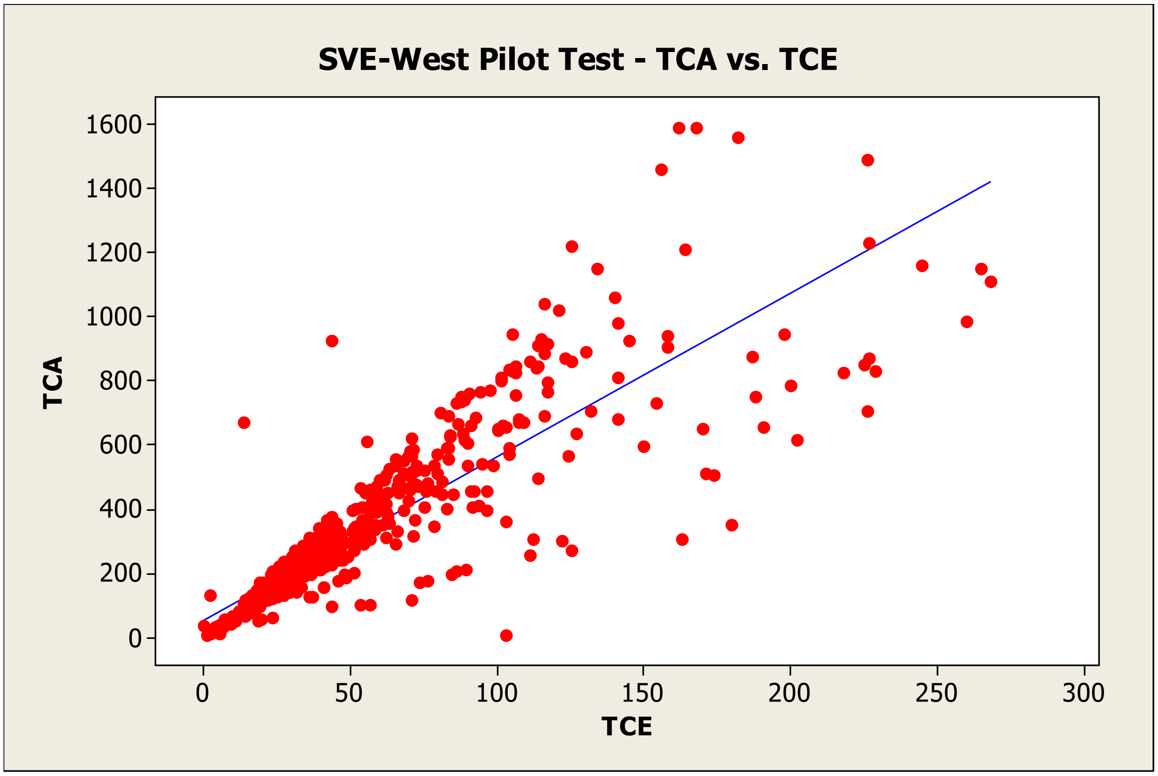

Scatterplots of Manometer Readings from Borehole 02021
Location = 54-2021 - 100
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
Date-Time

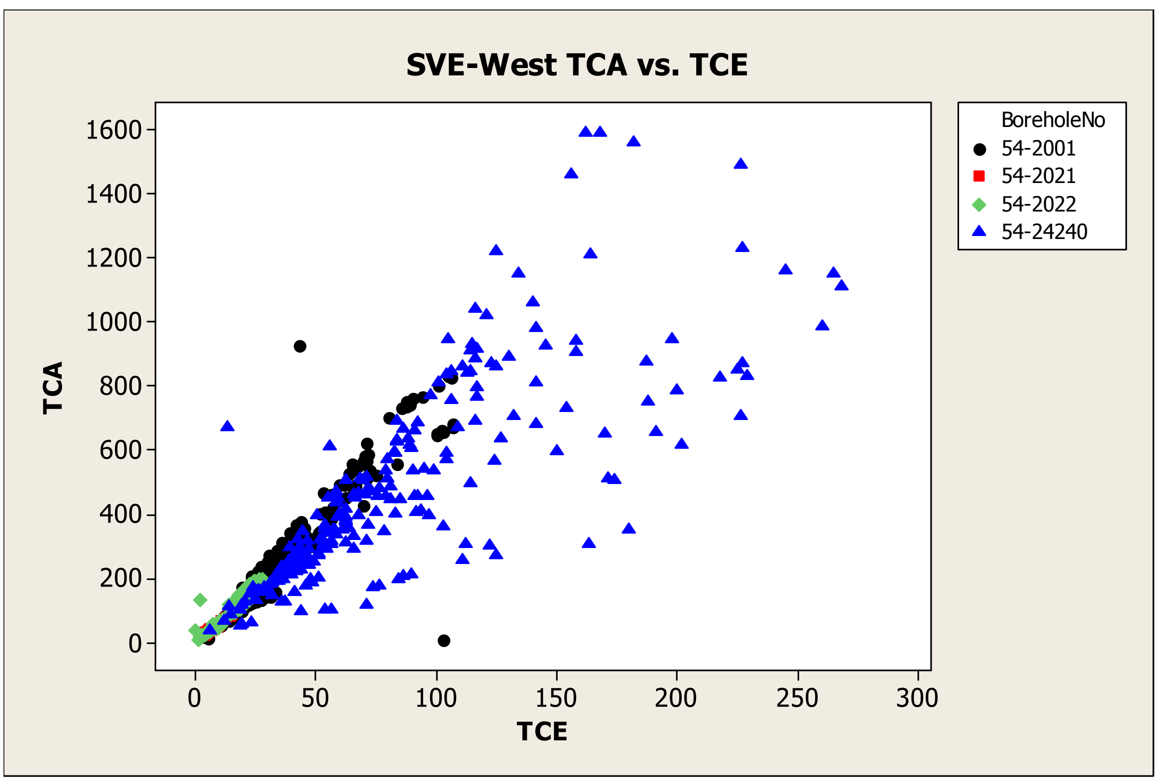

Scatterplots of Manometer Readings from Borehole 02021
Location = 54-2021 - 140
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
Date-Time

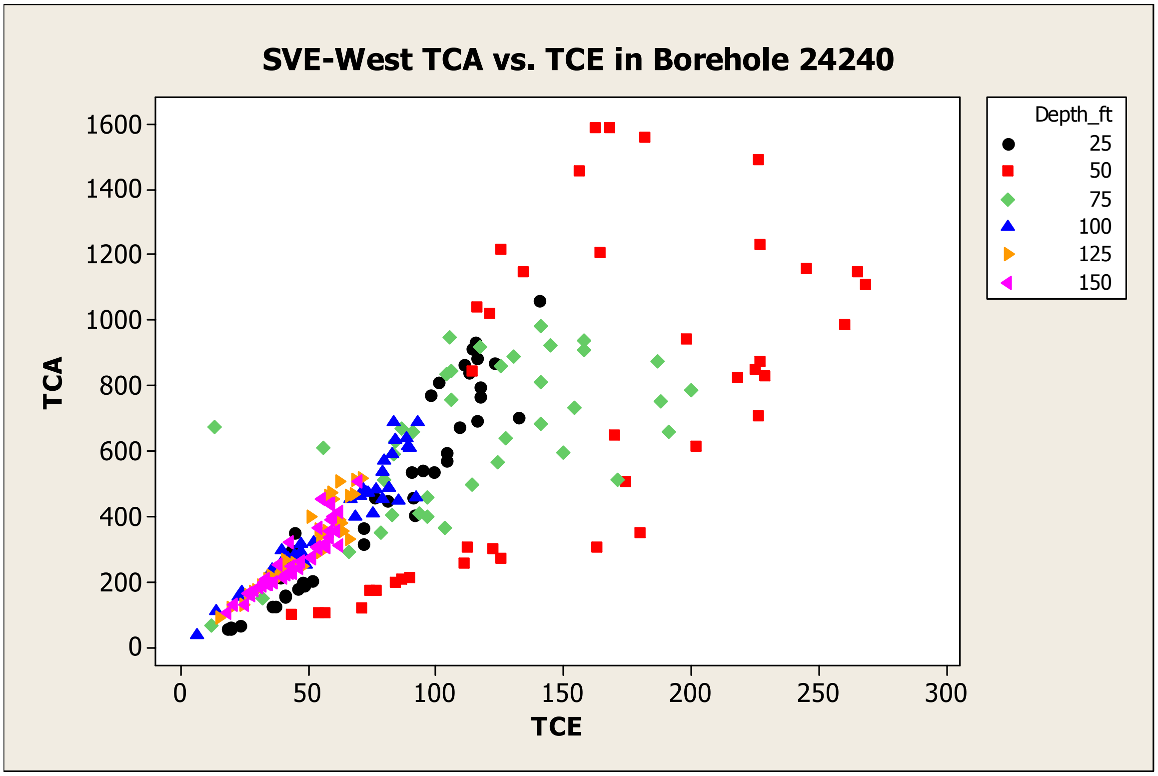

Scatterplots of Manometer Readings from Borehole 02021
Location = 54-2021 - 180
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
Date-Time

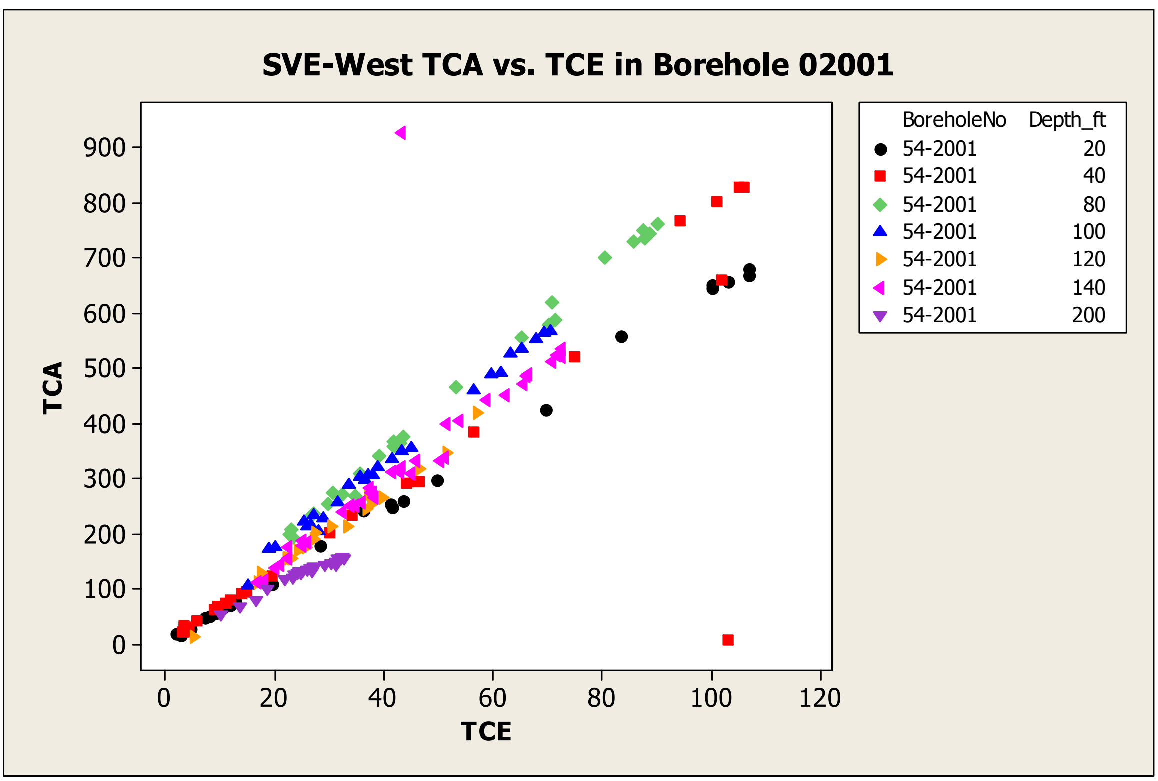

Scatterplots of Manometer Readings from Borehole 02021
Location = 54-2021 - 198
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
6/21/2006
6/26/2006
7/1/2006
7/6/2006
7/11/2006
Date-Time

SVE-West: Plots of TCA versus TCE

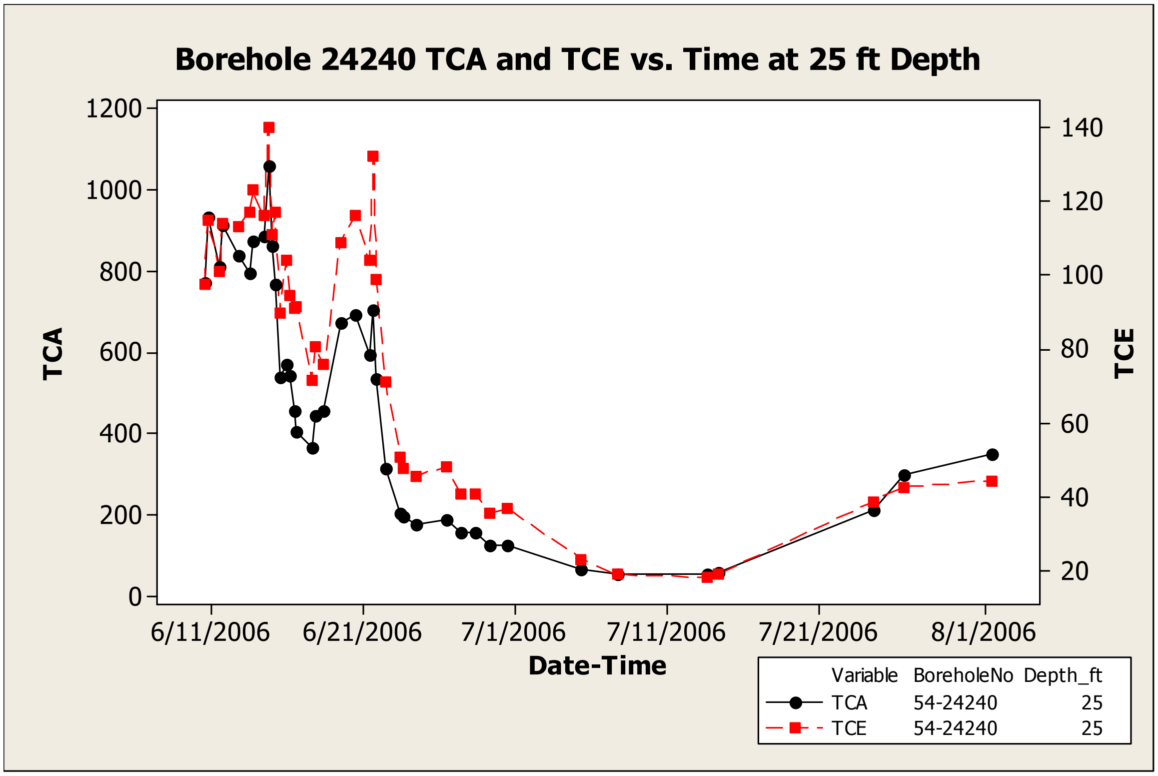


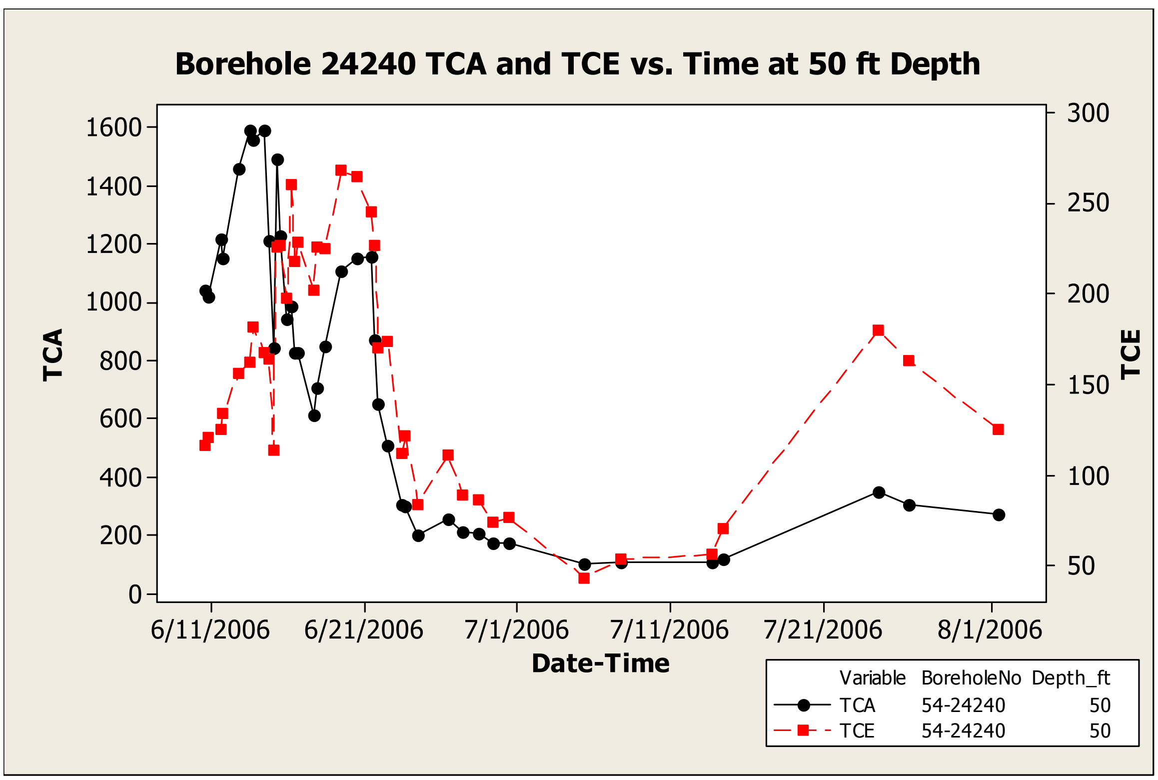


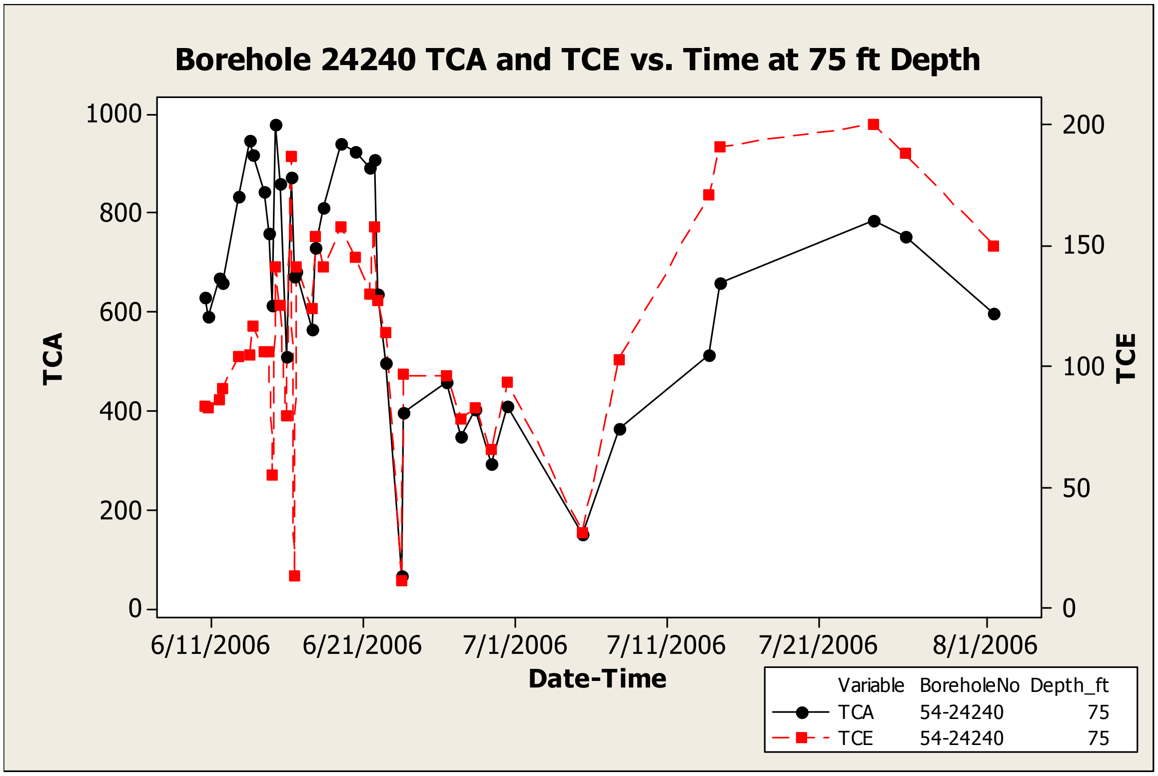

SVE-West TCA vs. TCE in Borehole 24240
TCA
TCE
Depth_ft
25
50
75
100
125
150

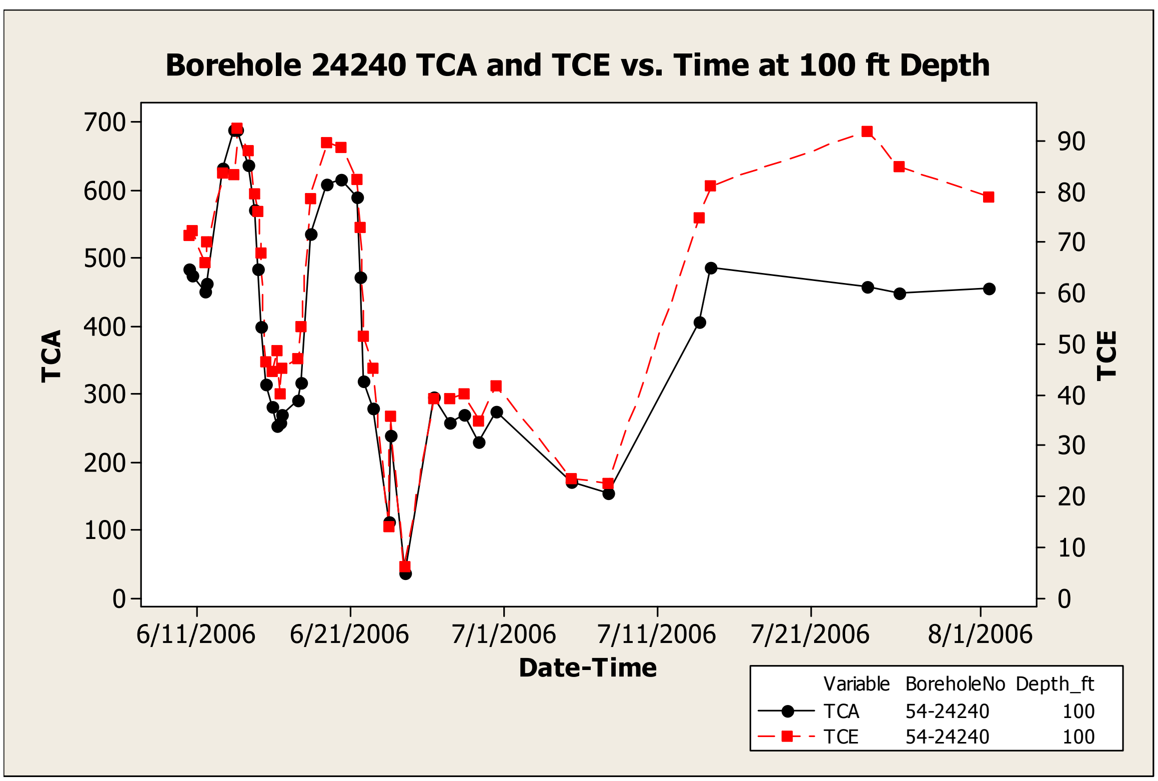

SVE-West TCA vs. TCE in Borehole 02001
TCA
TCE
BoreholeNo Depth_ft
54-2001 20
54-2001 40
54-2001 80
54-2001 100
54-2001 120
54-2001 140
54-2001 200

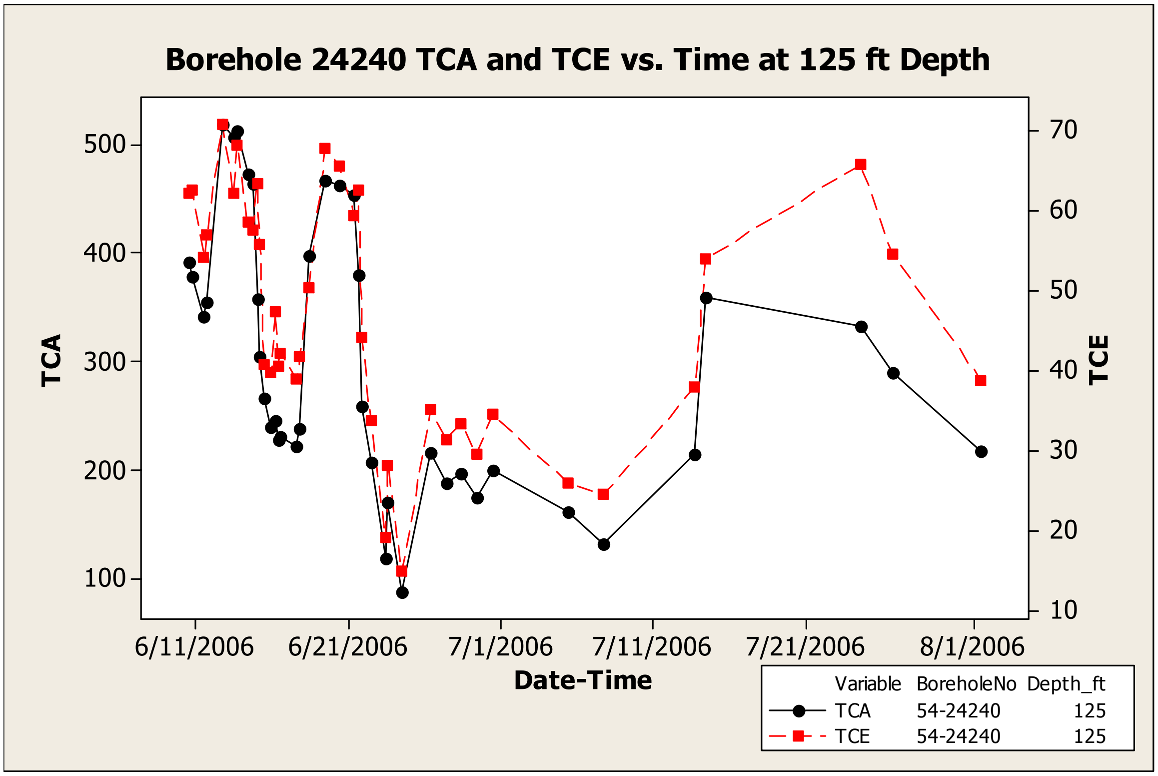
Plots of TCA and TCE versus Time for Borehole 54-24240

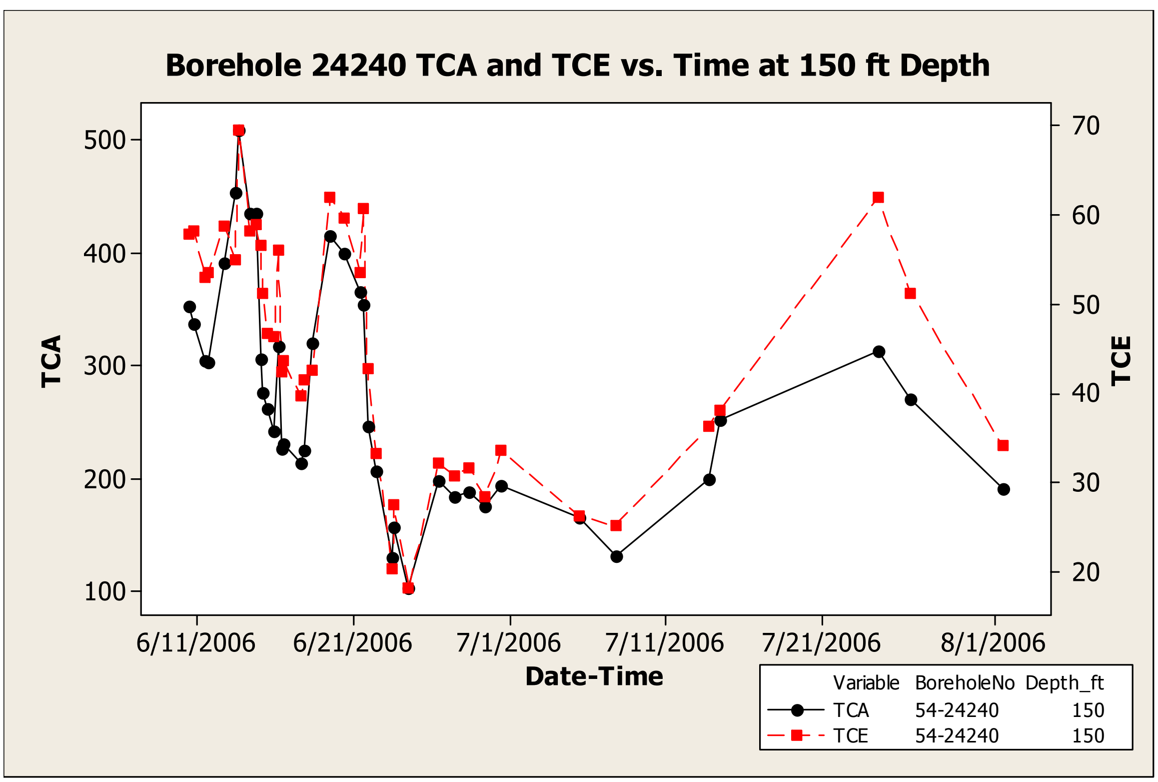




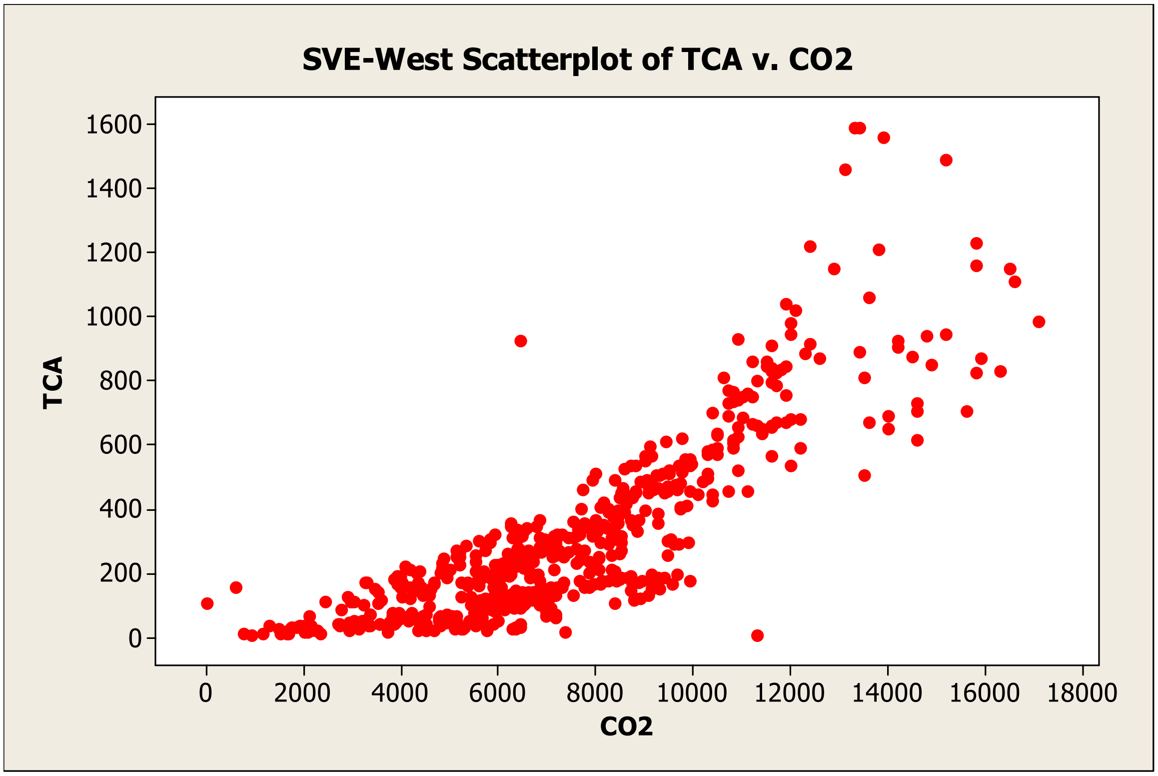

Borehole 24240 TCA and TCE vs. Time at 75 ft Depth
TCA
TCE
Date-Time
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Variable BoreholeNo Depth_ft
TCA 54-24240 75
TCE 54-24240 75

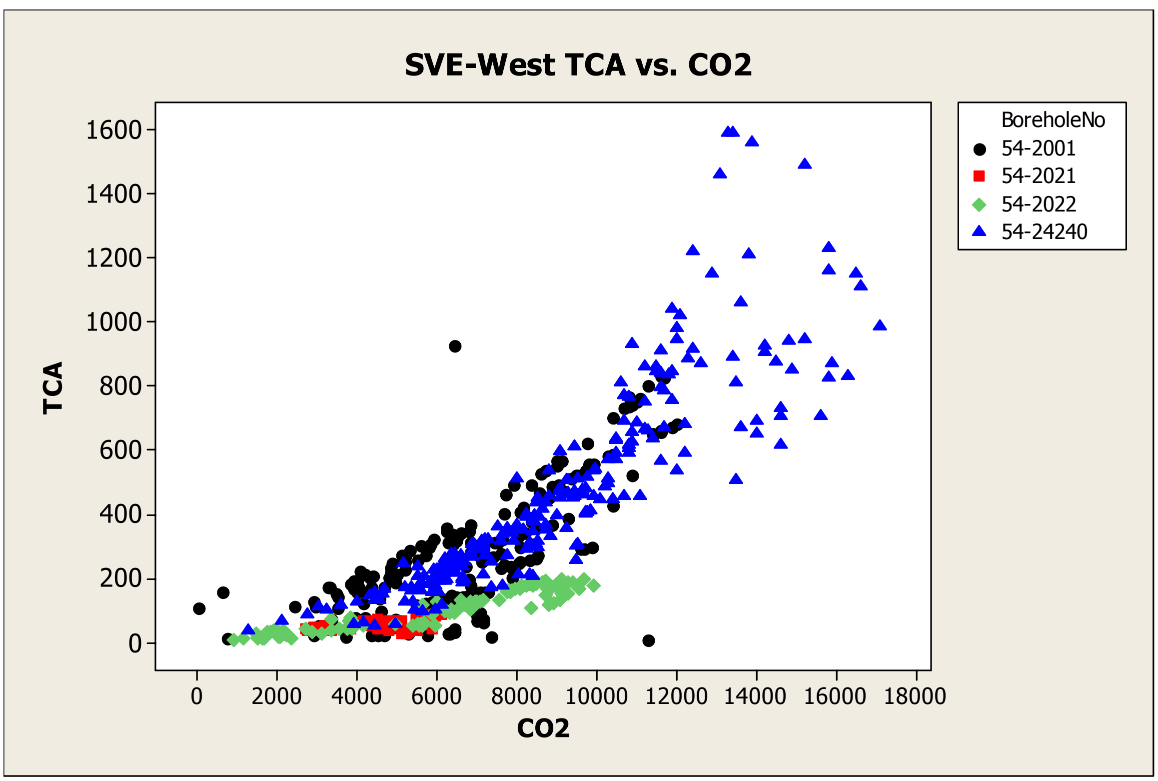

Borehole 24240 TCA and TCE vs. Time at 100 ft Depth
TCA
TCE
Date-Time
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Variable BoreholeNo Depth_ft
TCA 54-24240 100
TCE 54-24240 100

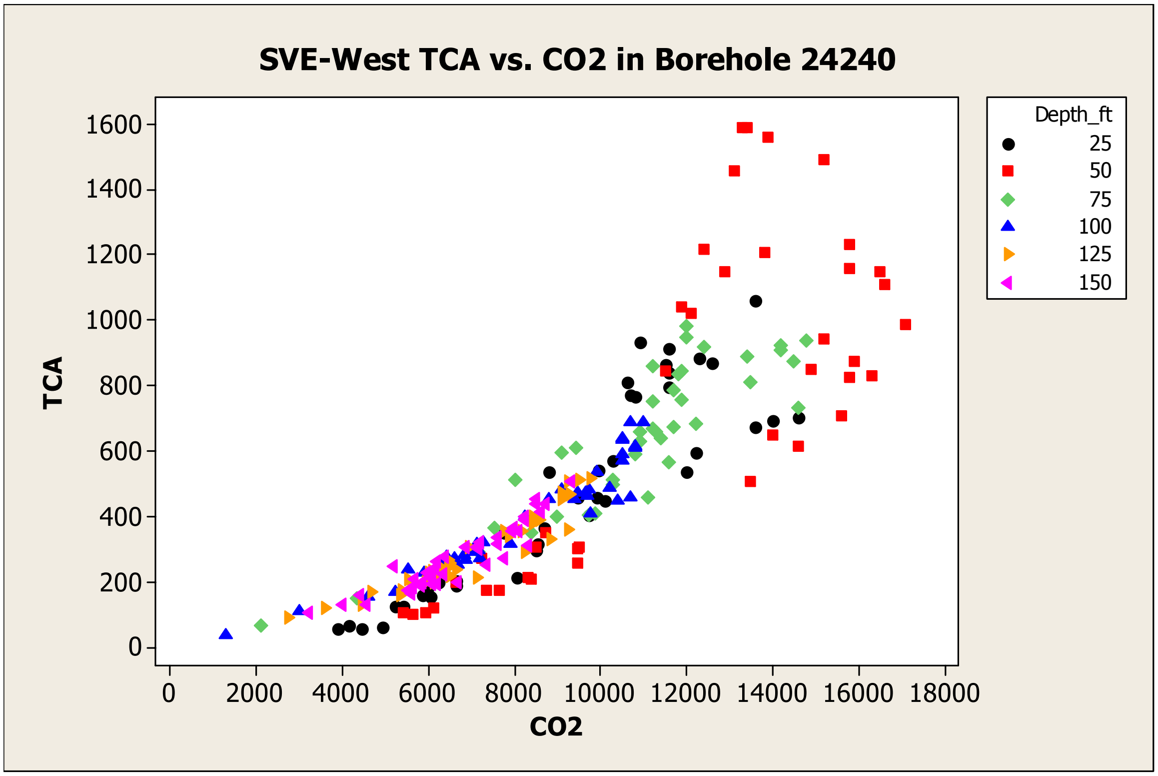

Borehole 24240 TCA and TCE vs. Time at 125 ft Depth
TCA
TCE
100
200
300
400
500
10
20
30
40
50
60
70
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time
Variable BoreholeNo Depth_ft
TCA 54-24240 125
TCE 54-24240 125


Borehole 24240 TCA and TCE vs. Time at 150 ft Depth
TCA
TCE
100
200
300
400
500
20
30
40
50
60
70
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time
Variable BoreholeNo Depth_ft
TCA 54-24240 150
TCE 54-24240 150

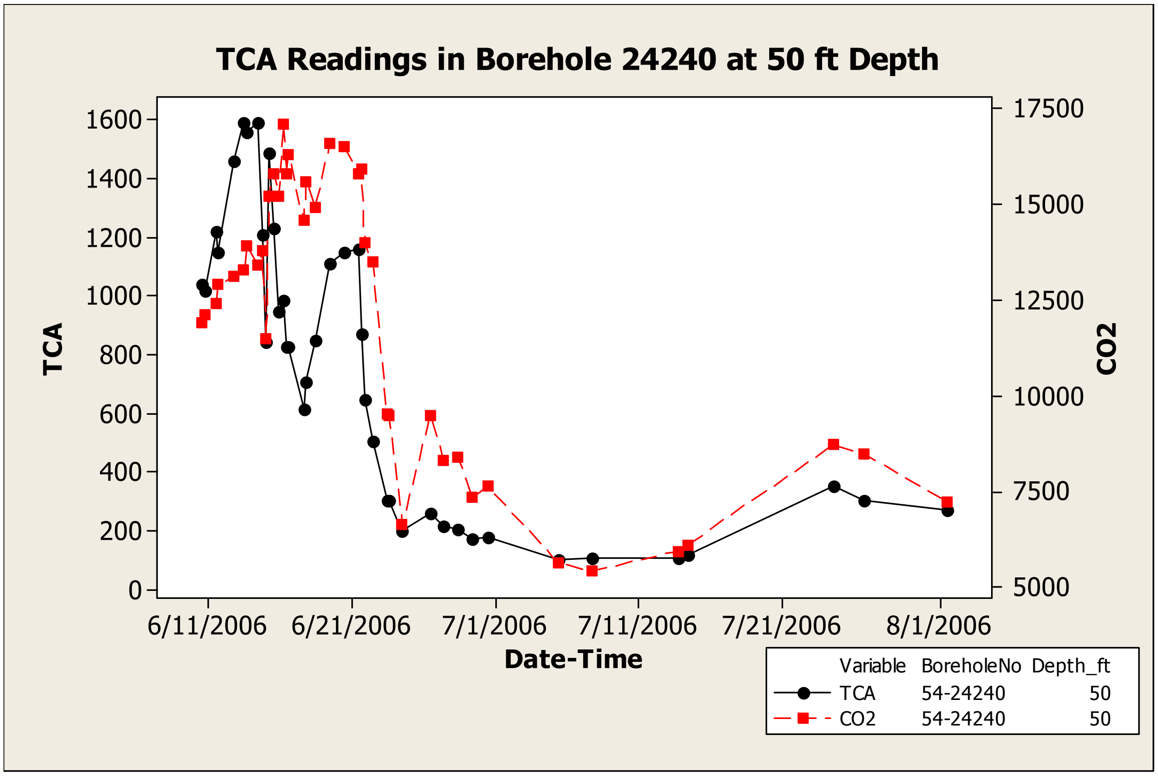
SVE-West TCA versus Carbon Dioxide Plots

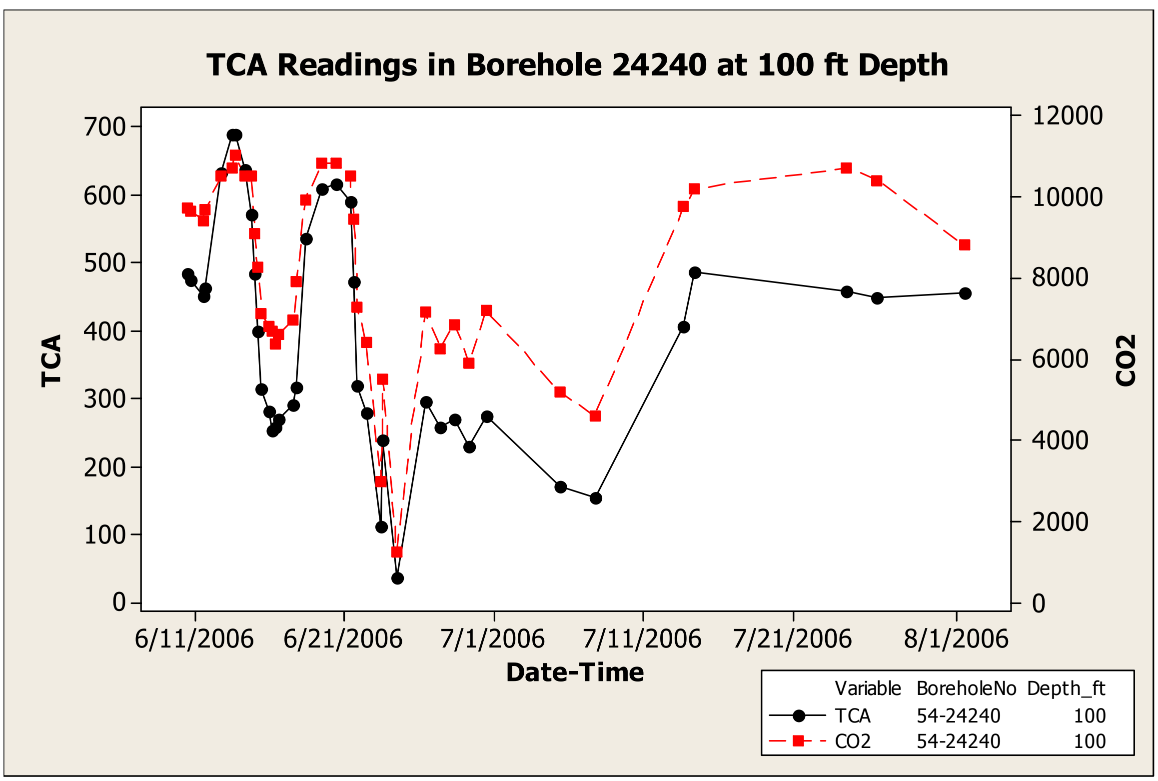


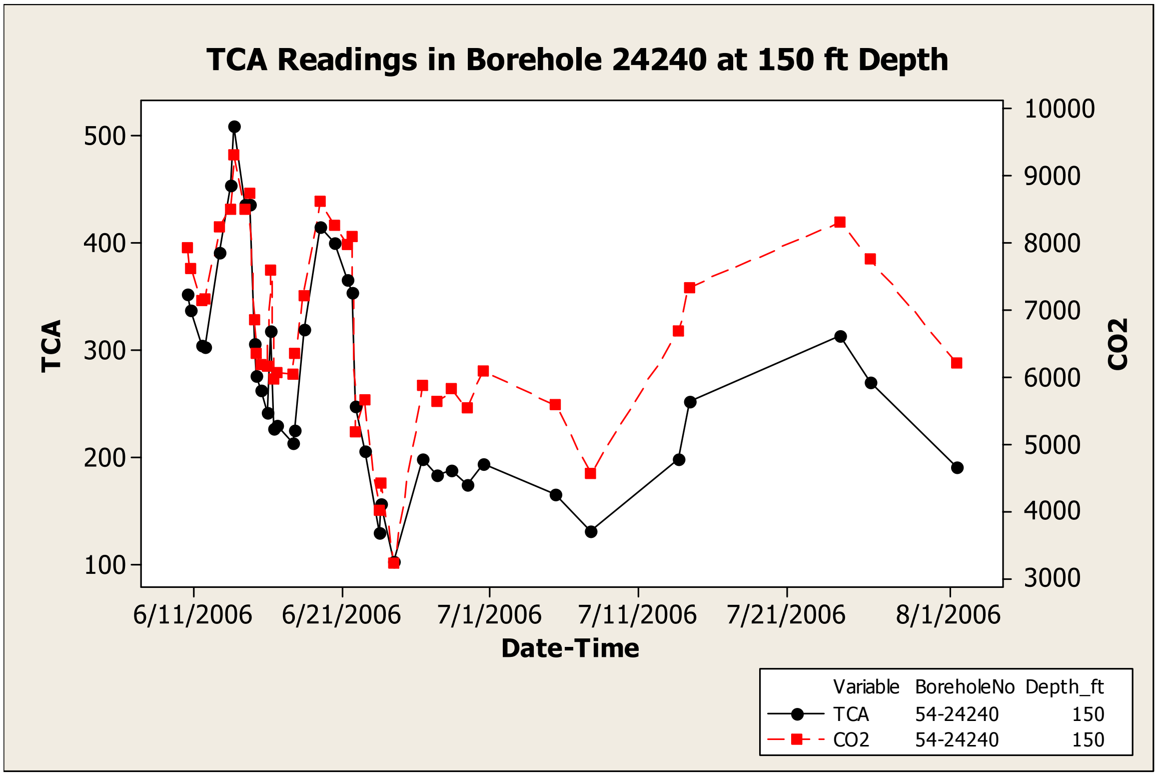


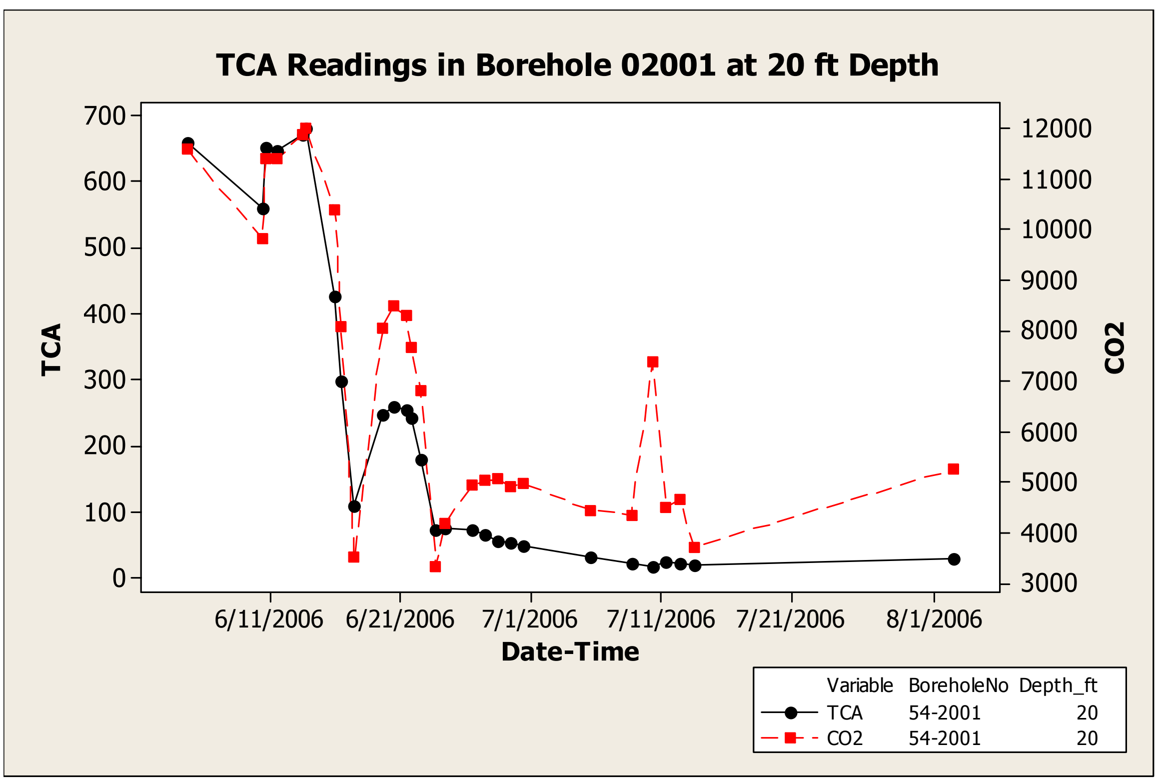

SVE-West TCA vs. CO2 in Borehole 24240
TCA
CO2
0
200
400
600
800
1000
1200
1400
1600
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Depth_ft
25
50
75
100
125
150

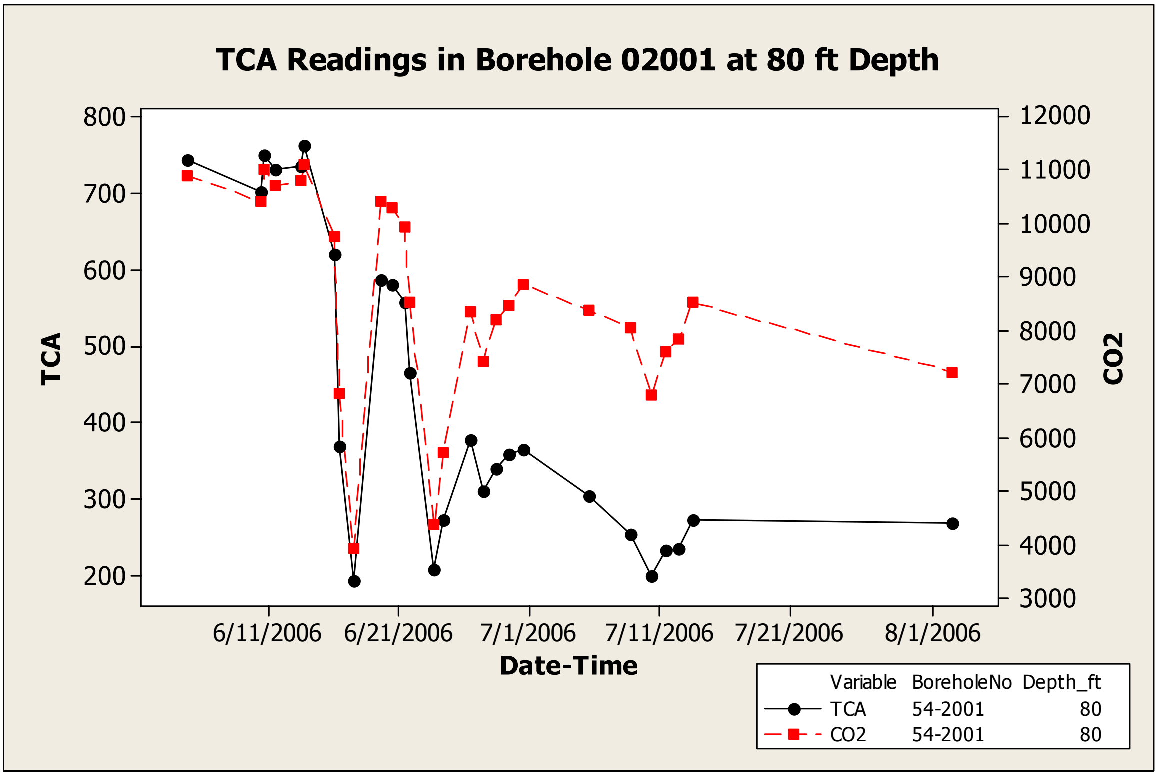
TCA and Carbon Dioxide versus Time for Borehole 54-24240

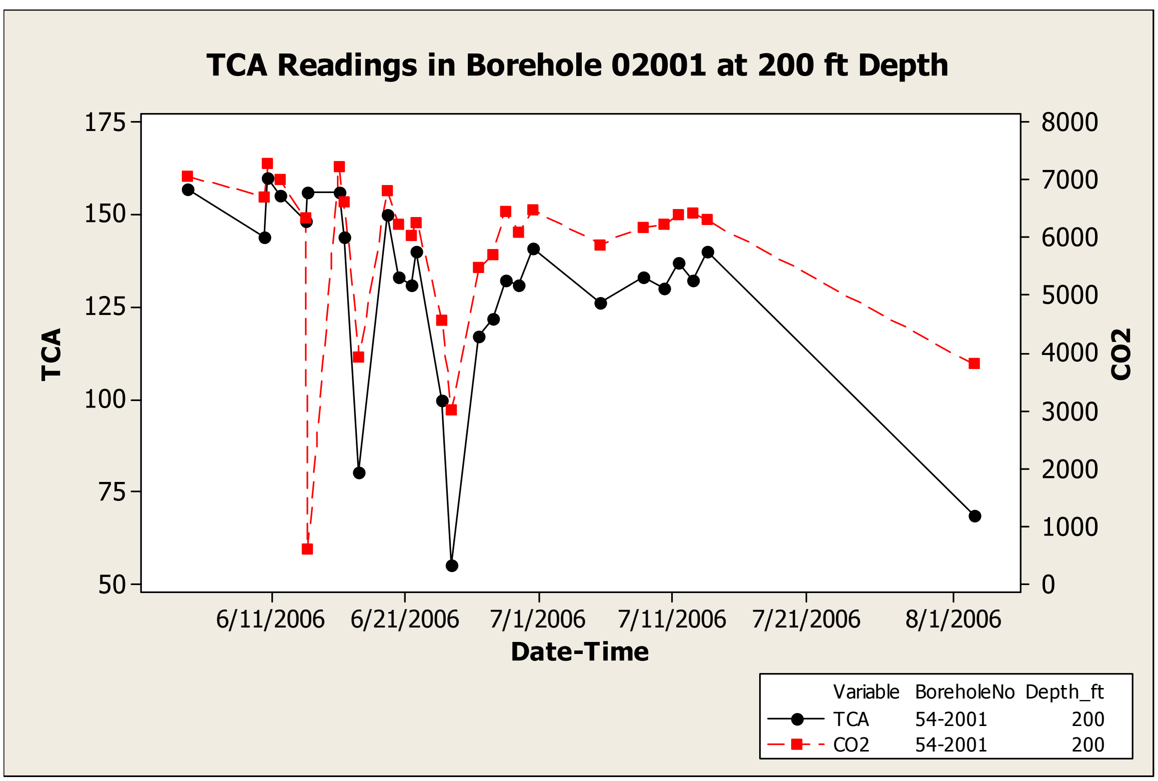





TCA Readings in Borehole 24240 at 150 ft Depth
TCA
CO2
Date-Time
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Variable BoreholeNo Depth_ft
TCA 54-24240 150
CO2 54-24240 150


TCA Readings in Borehole 02001 at 20 ft Depth
TCA
CO2
Date-Time
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Variable BoreholeNo Depth_ft
TCA 54-2001 20
CO2 54-2001 20

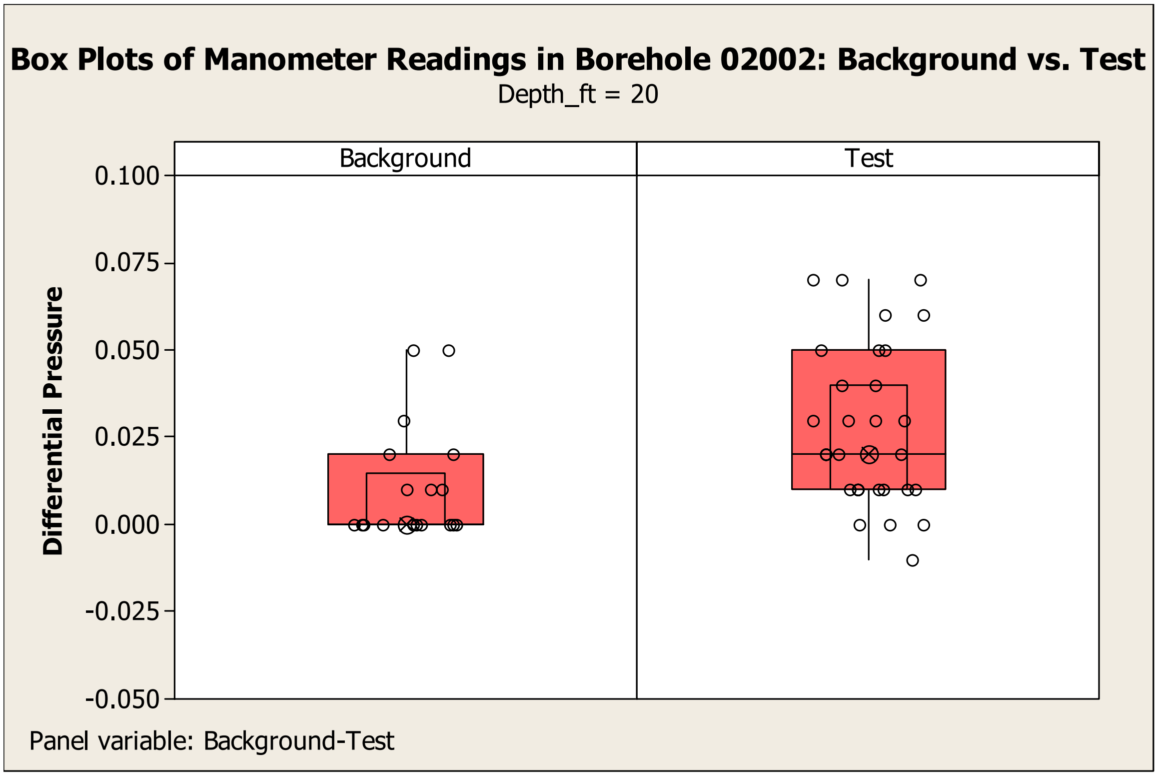

TCA Readings in Borehole 02001 at 80 ft Depth
TCA
CO2
800
700
600
500
400
300
200
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time
Variable BoreholeNo Depth_ft
TCA 54-2001 80
CO2 54-2001 80

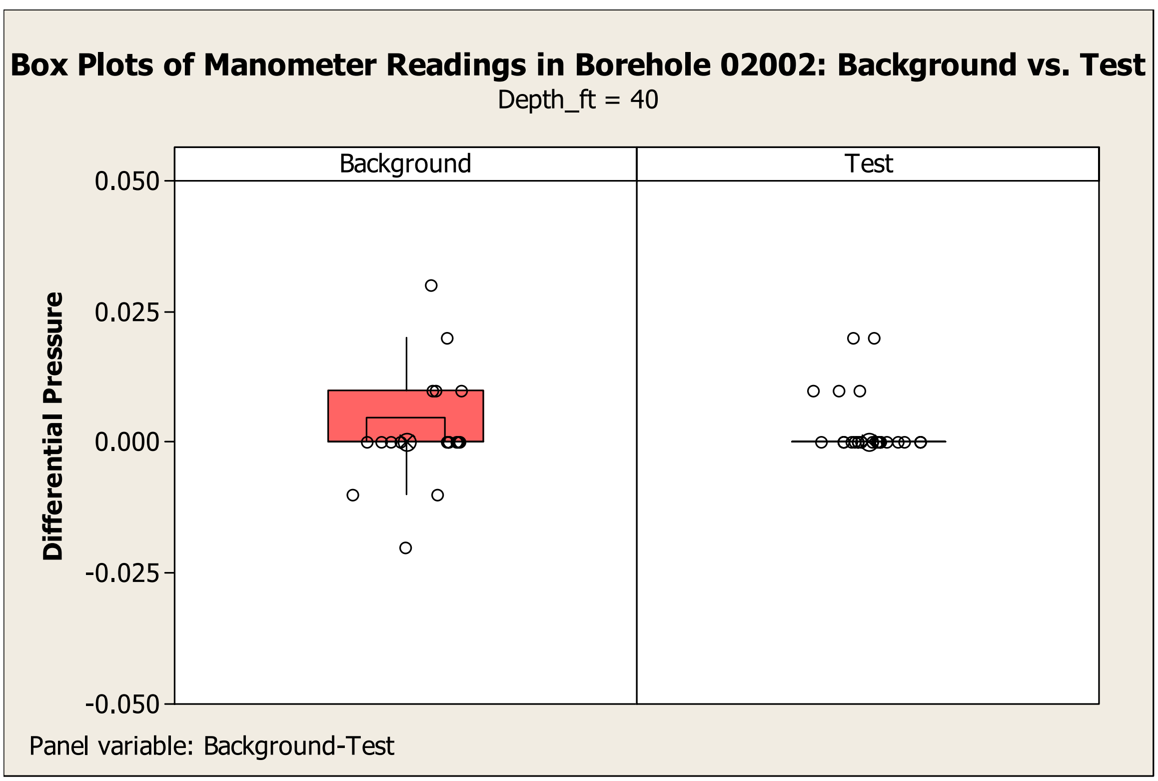

TCA Readings in Borehole 02001 at 200 ft Depth
TCA
CO2
175
150
125
100
75
50
8000
7000
6000
5000
4000
3000
2000
1000
0
6/11/2006
6/21/2006
7/1/2006
7/11/2006
7/21/2006
8/1/2006
Date-Time
Variable BoreholeNo Depth_ft
TCA 54-2001 200
CO2 54-2001 200

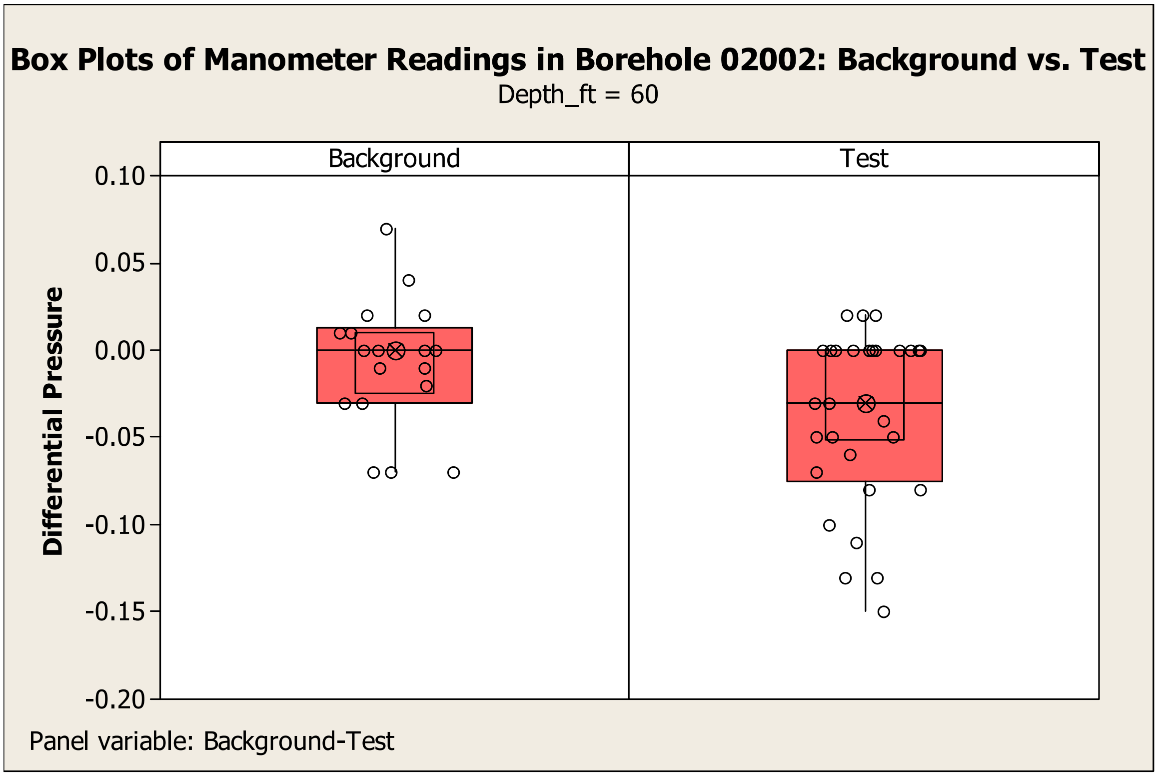
Attachment 2

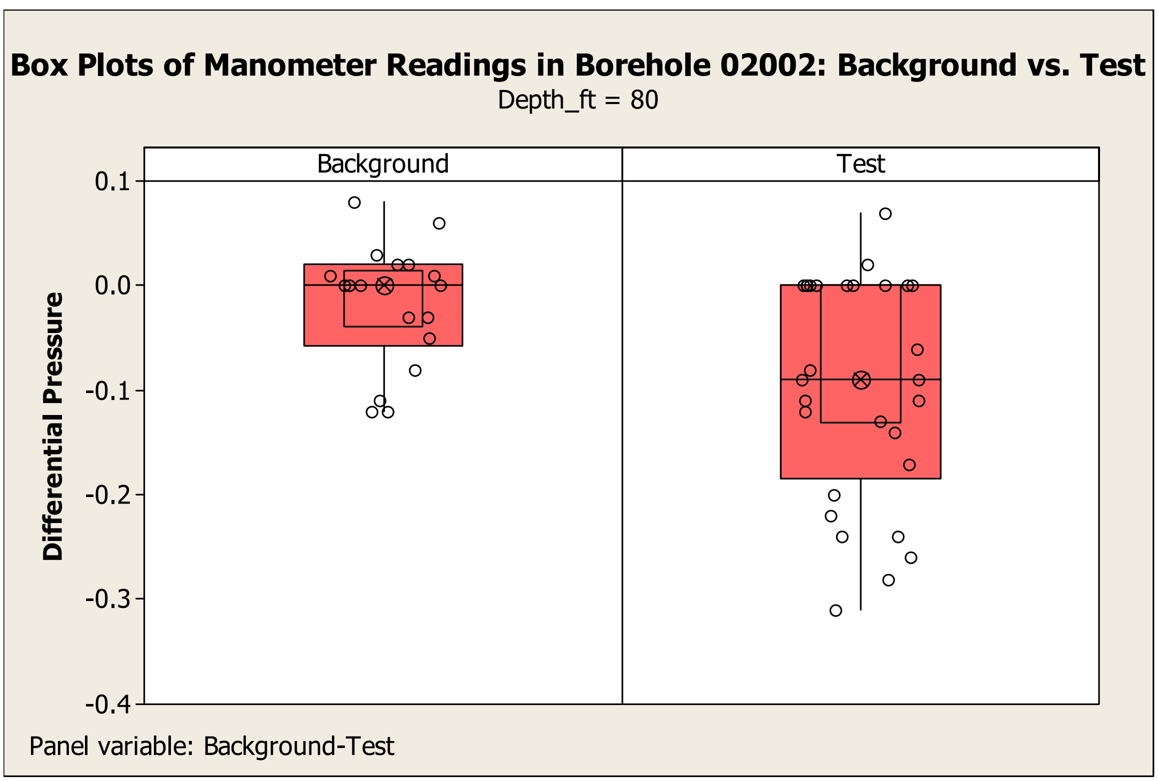
SVE East
Additional Figures Showing
Manometer Readings and Chemical Correlations

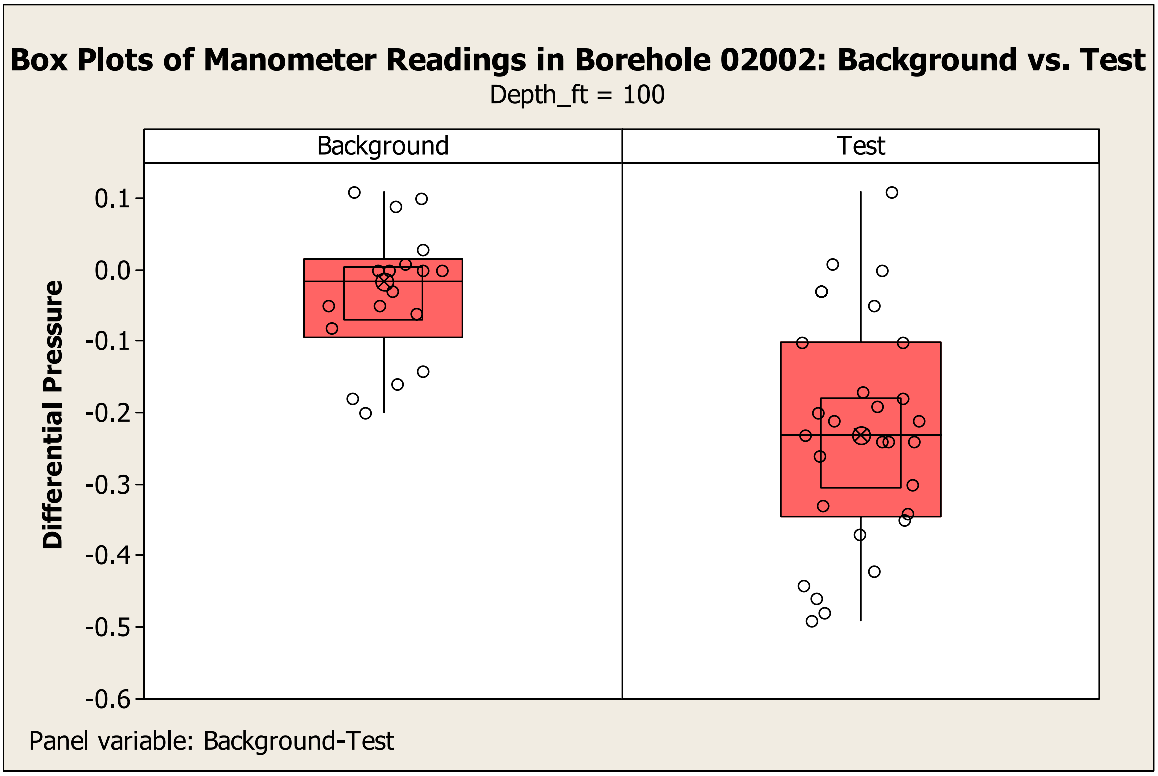
Boxplots of Manometer Readings in Borehole 54-02002

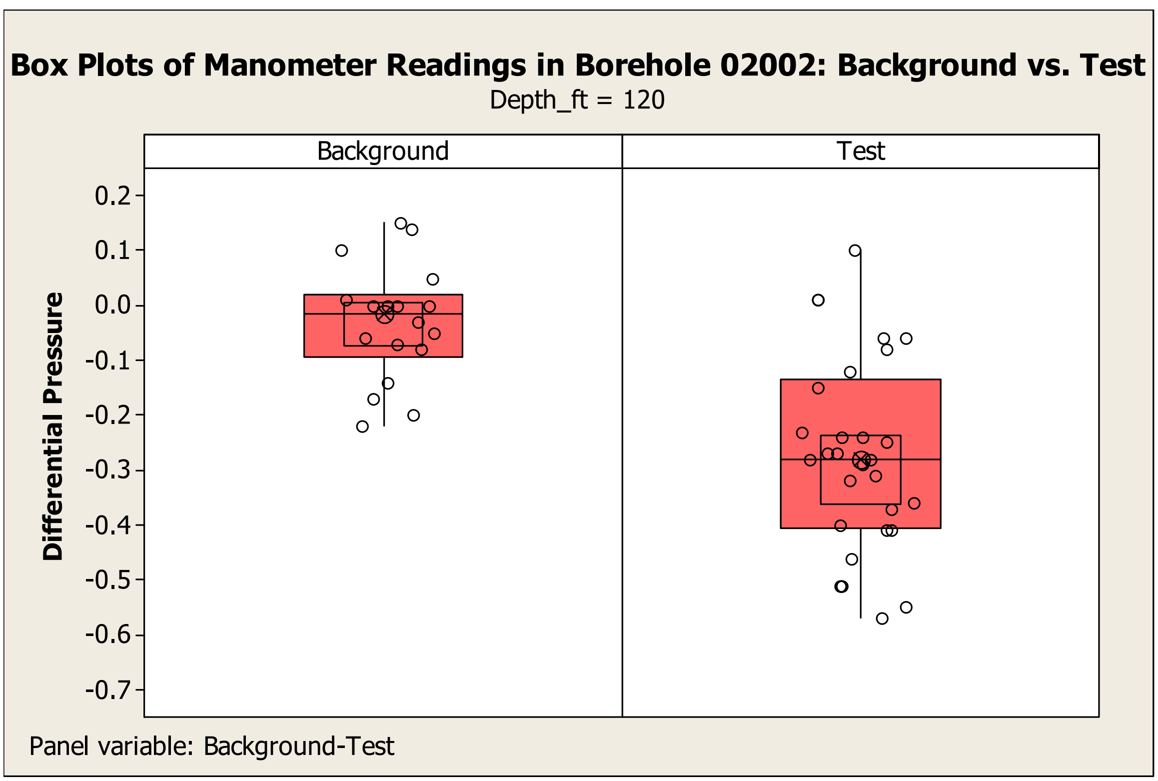


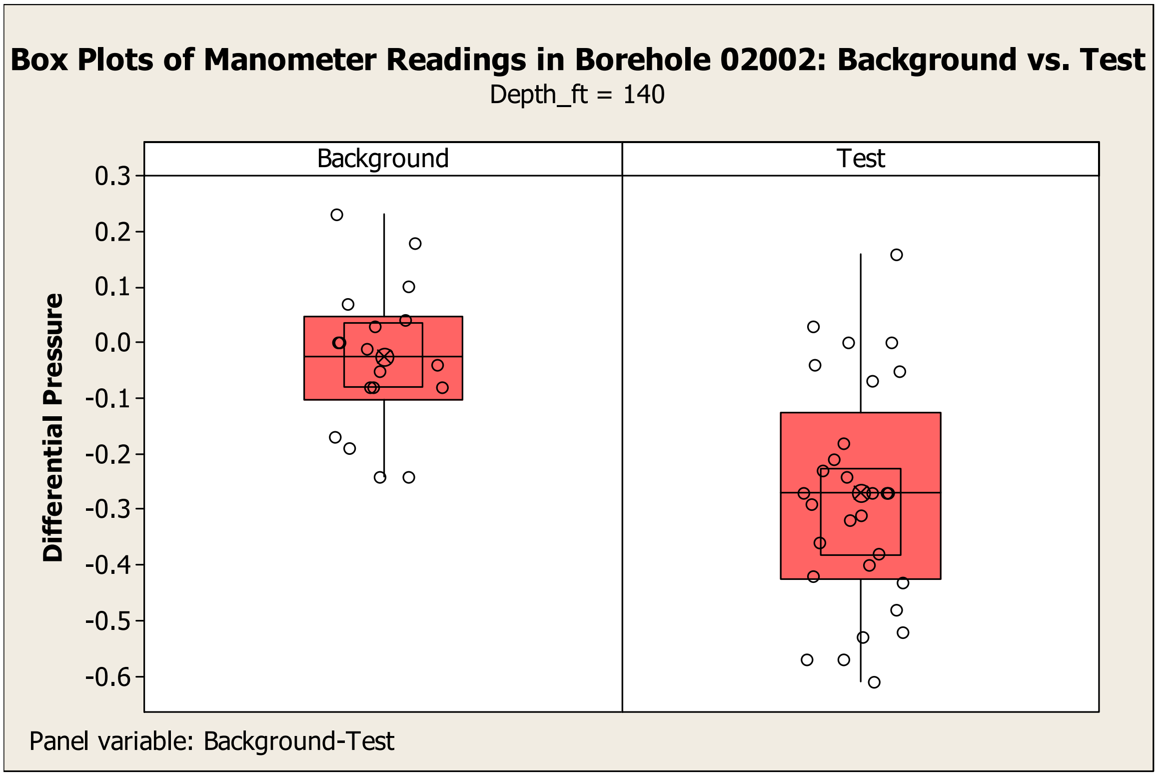


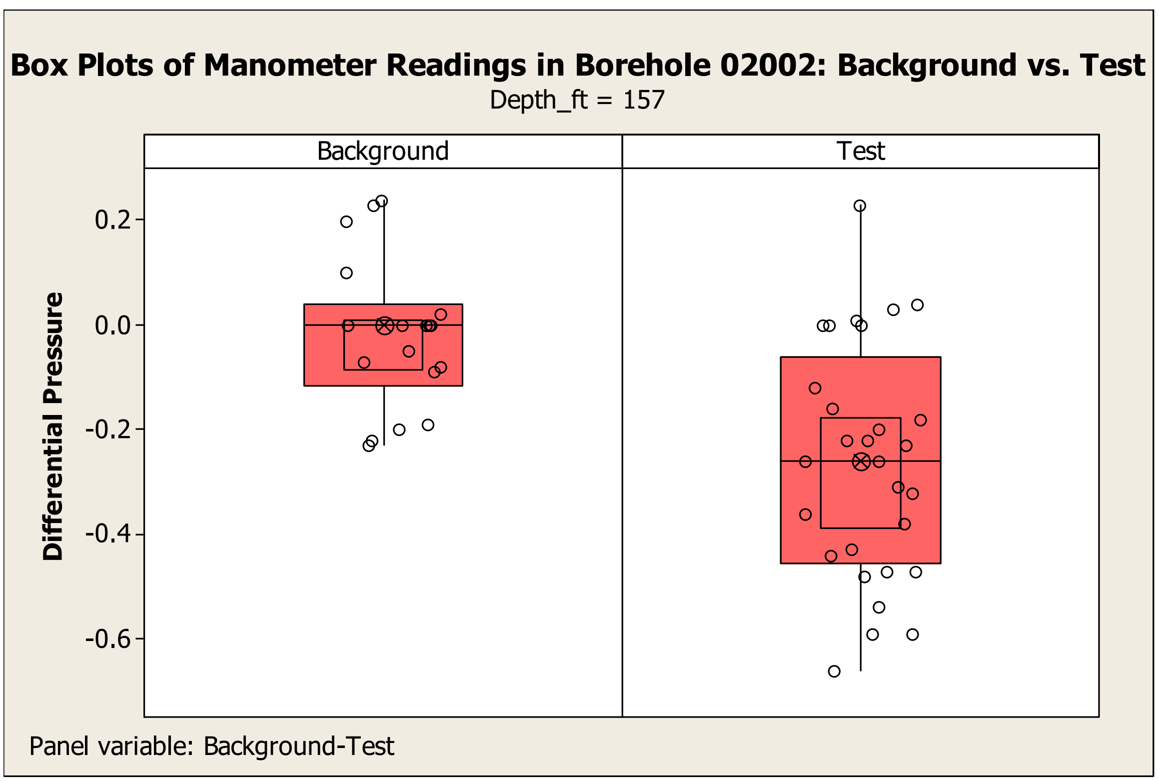

Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 60
Background
Test
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
Panel variable: Background-Test

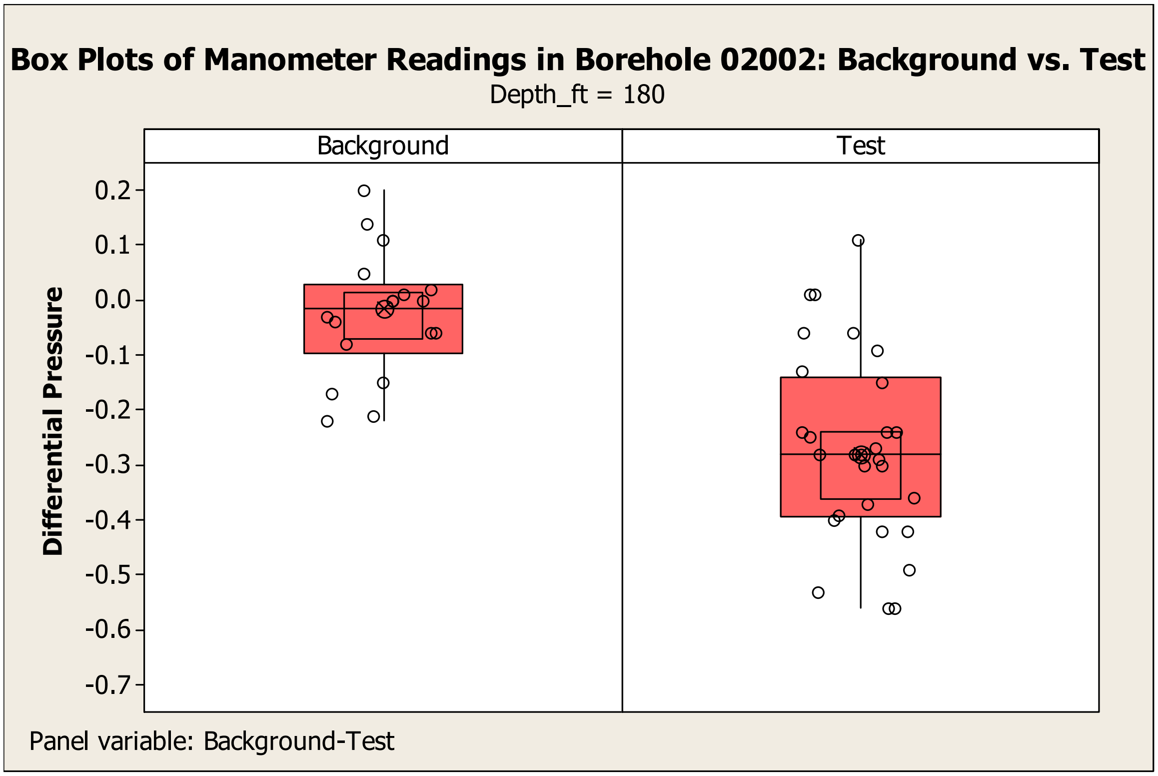

Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 80
Background
Test
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Panel variable: Background-Test

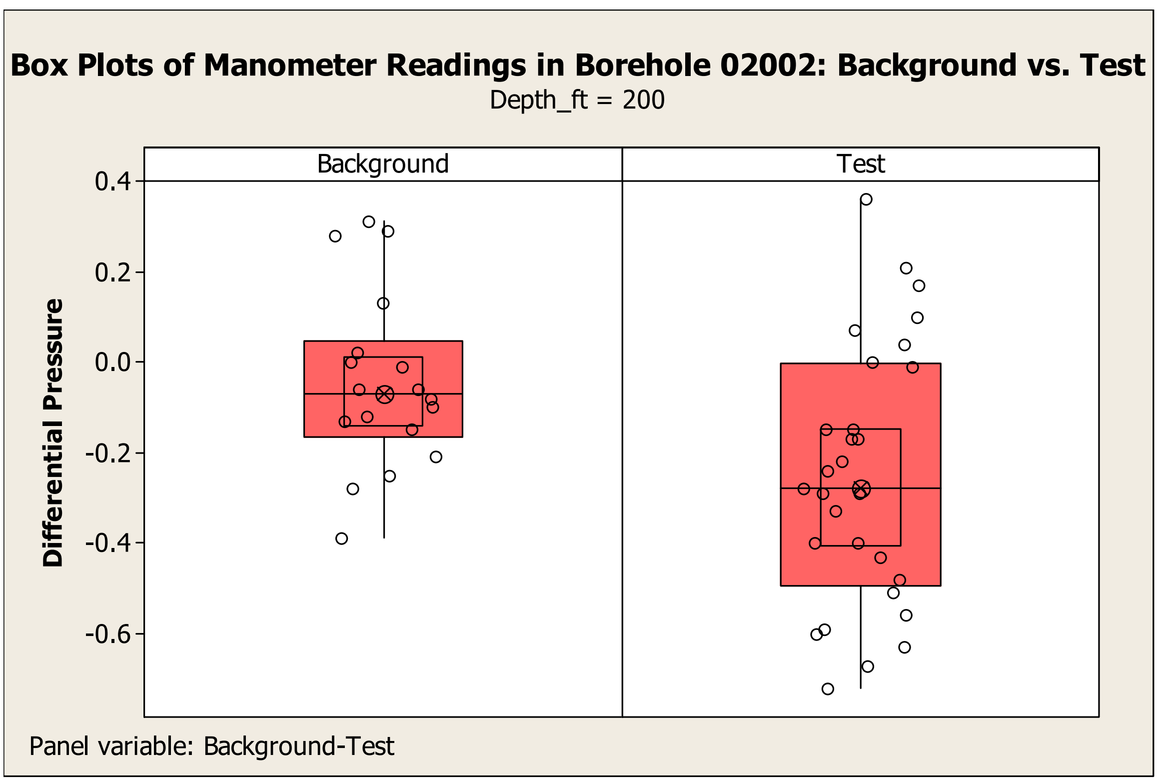

Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 100
Background
Test
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Panel variable: Background-Test


Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 120
Background
Test
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
Panel variable: Background-Test

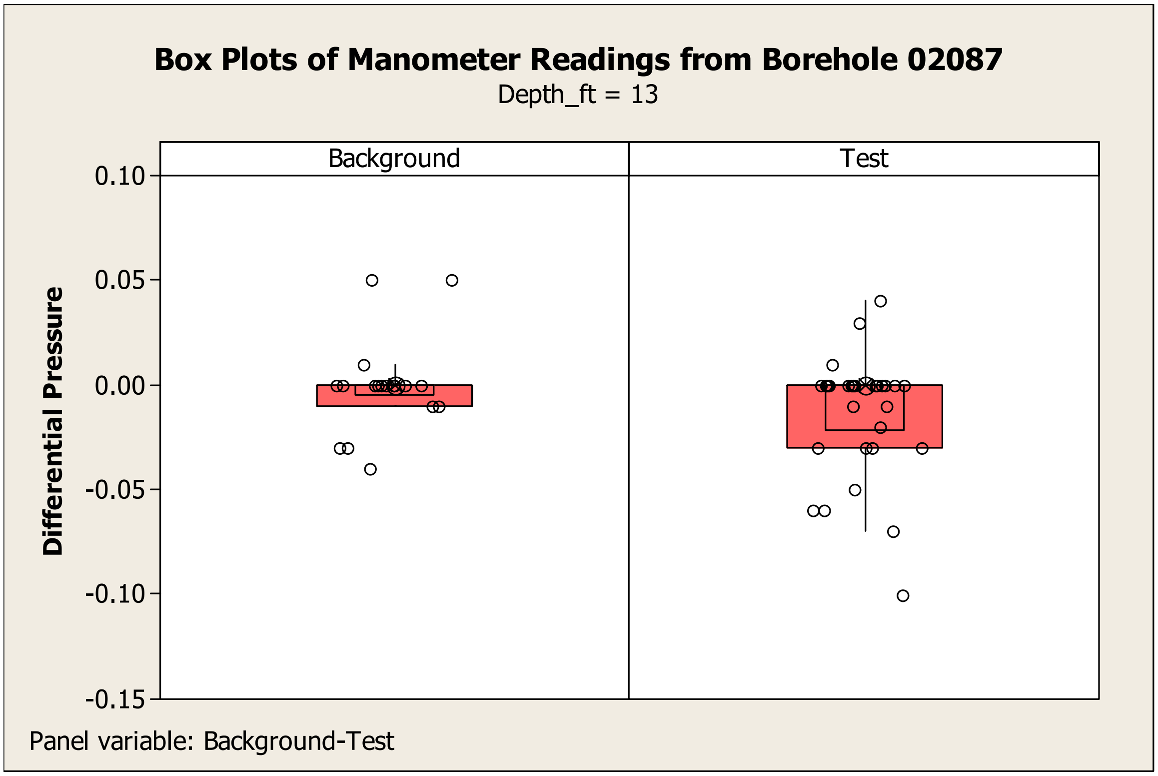

Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 140
Background
Test
Differential Pressure
0.3
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Panel variable: Background-Test

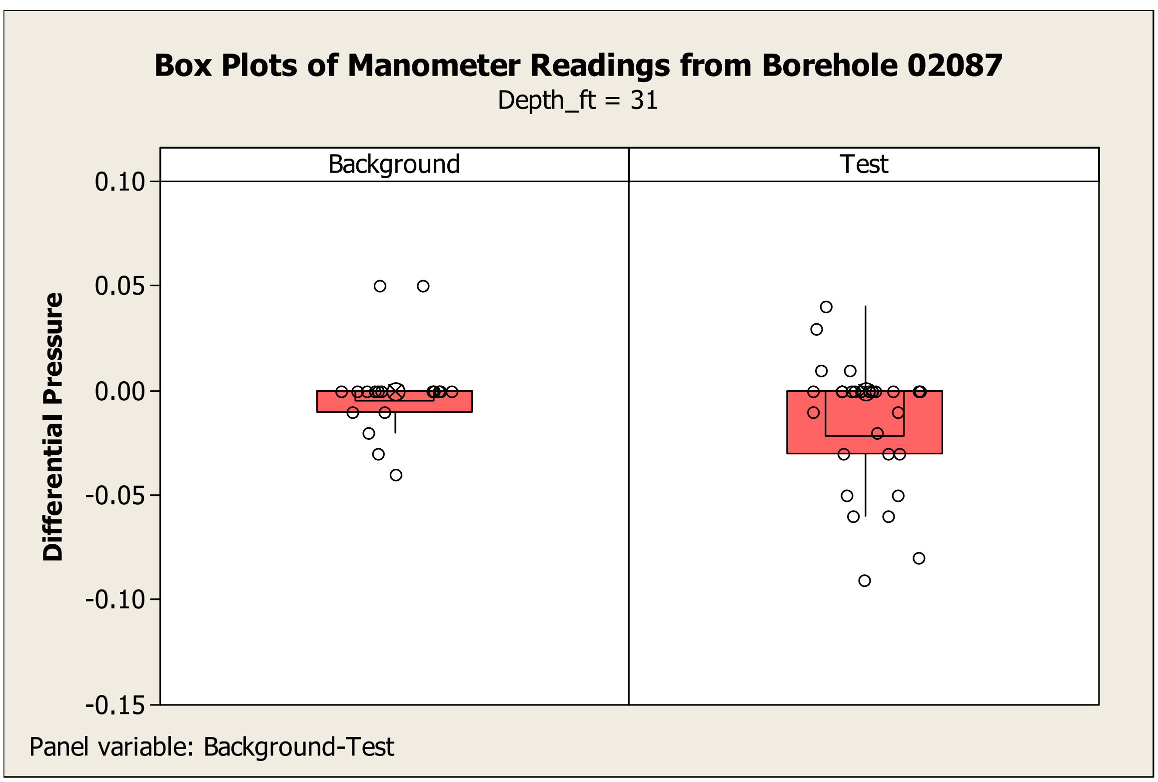

Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 157
Background
Test
Differential Pressure
0.2
0.0
-0.2
-0.4
-0.6
Panel variable: Background-Test

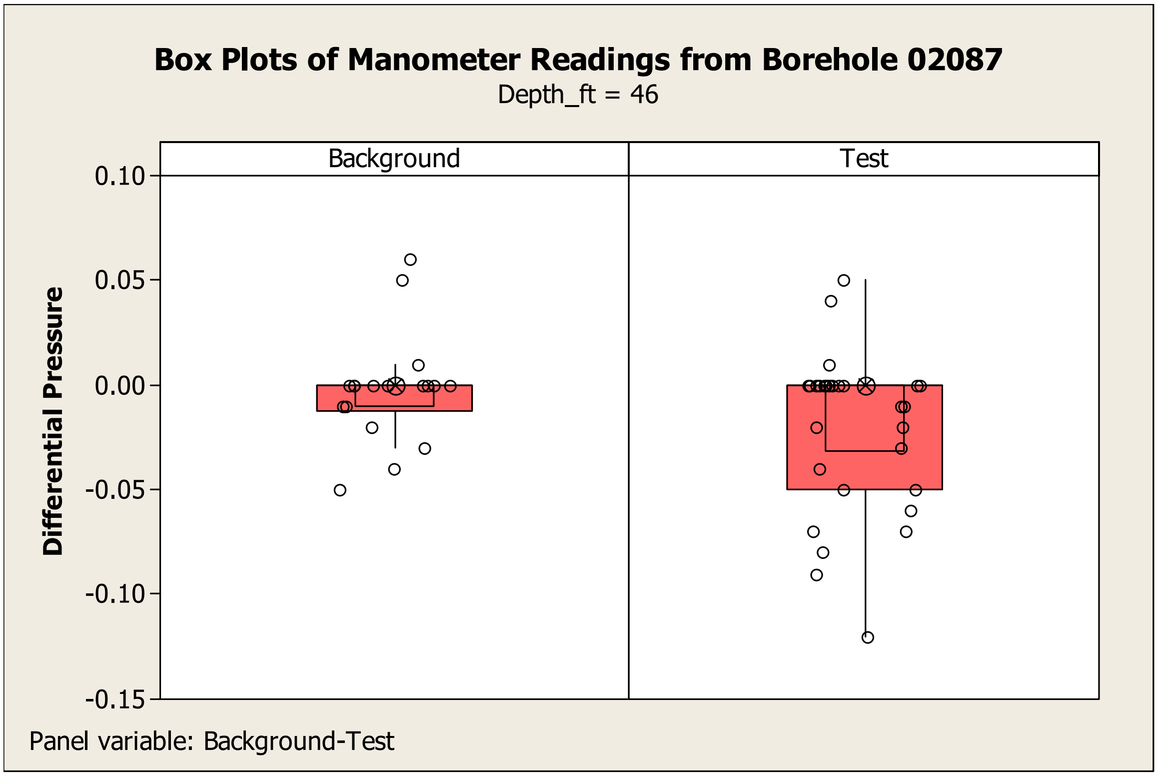

Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 180
Background
Test
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
Panel variable: Background-Test


Box Plots of Manometer Readings in Borehole 02002: Background vs. Test
Depth_ft = 200
Background
Test
Differential Pressure
0.4
0.2
0.0
-0.2
-0.4
-0.6
Panel variable: Background-Test

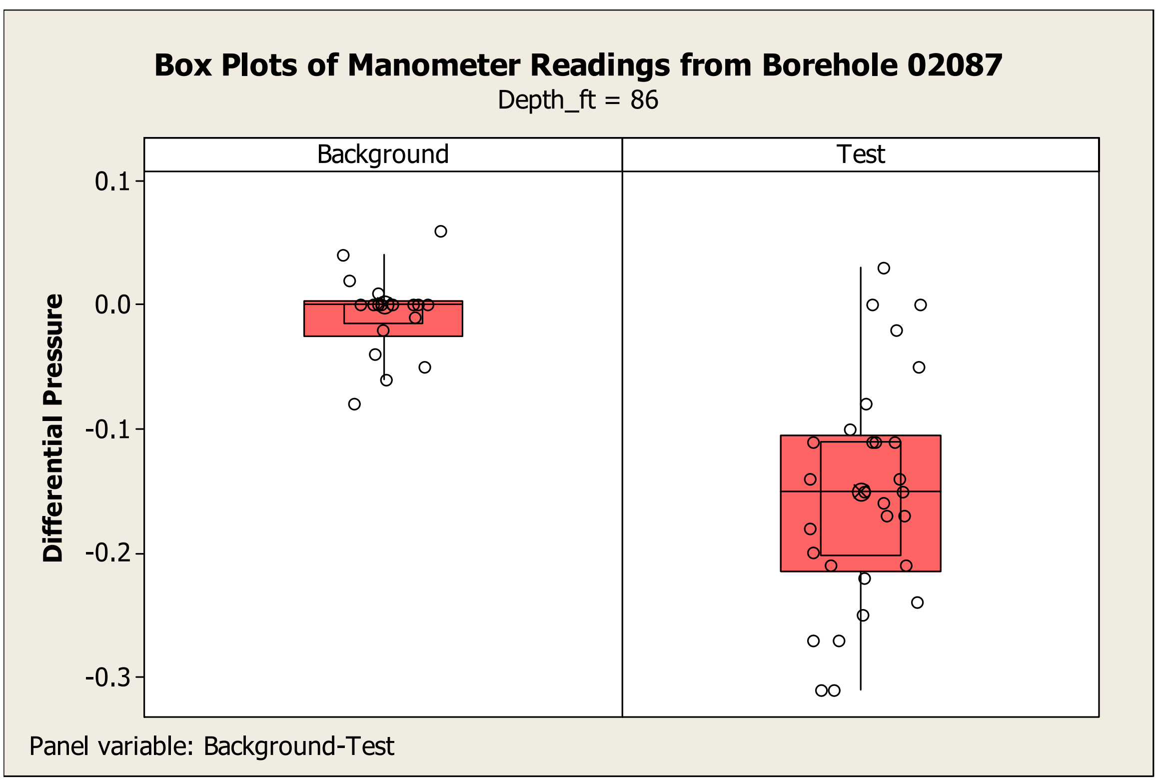
Boxplots of Manometer Readings from Borehole 54-02087





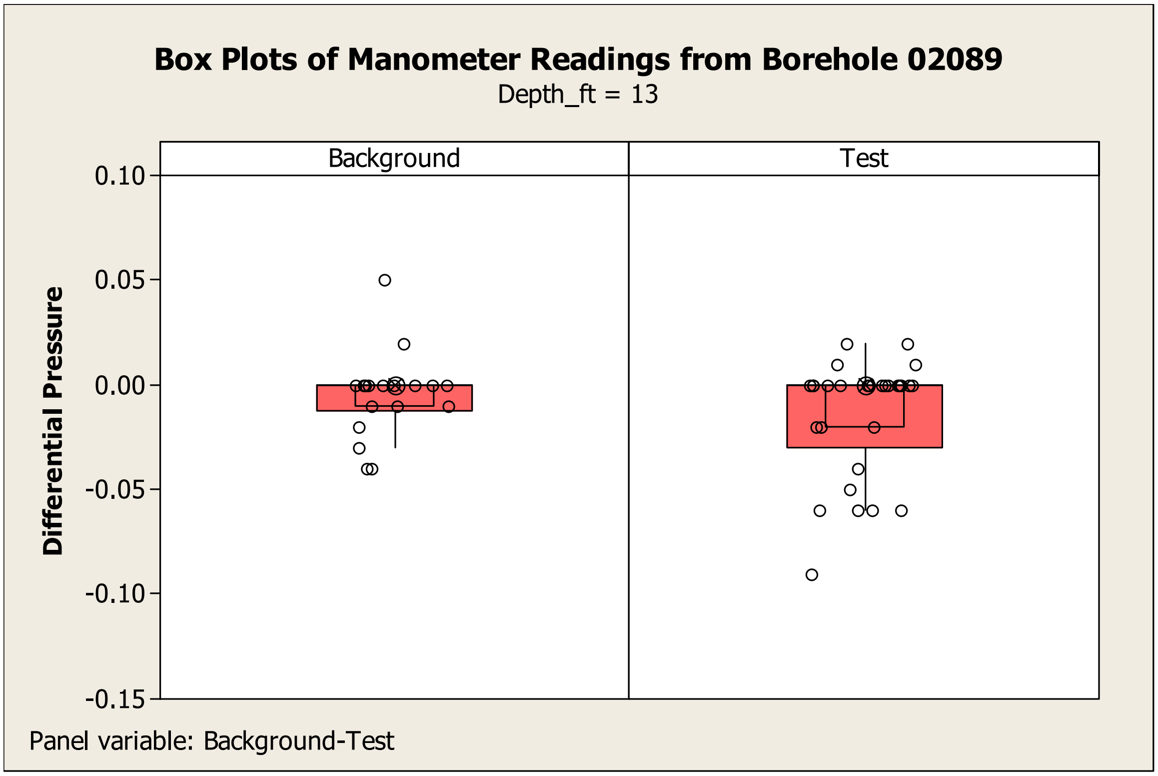


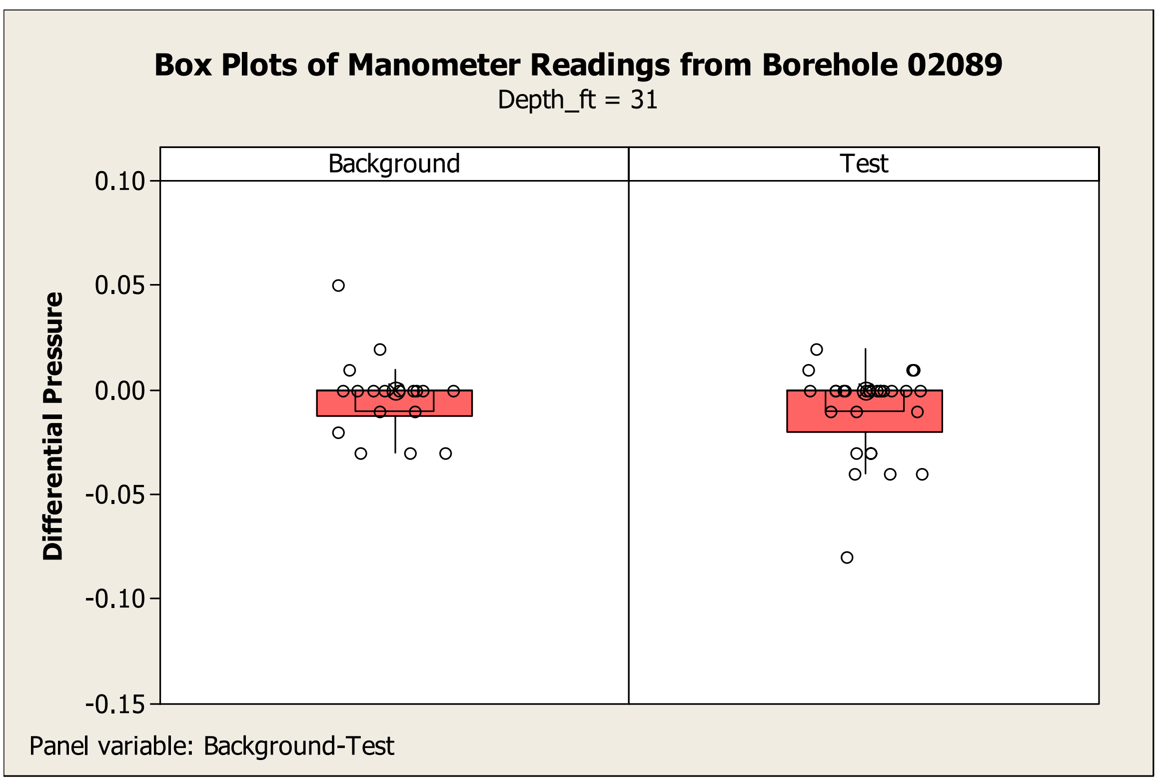
Box Plots of Manometer Readings from Borehole 02087
Depth_ft = 46
Background
Test
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
Panel variable: Background-Test

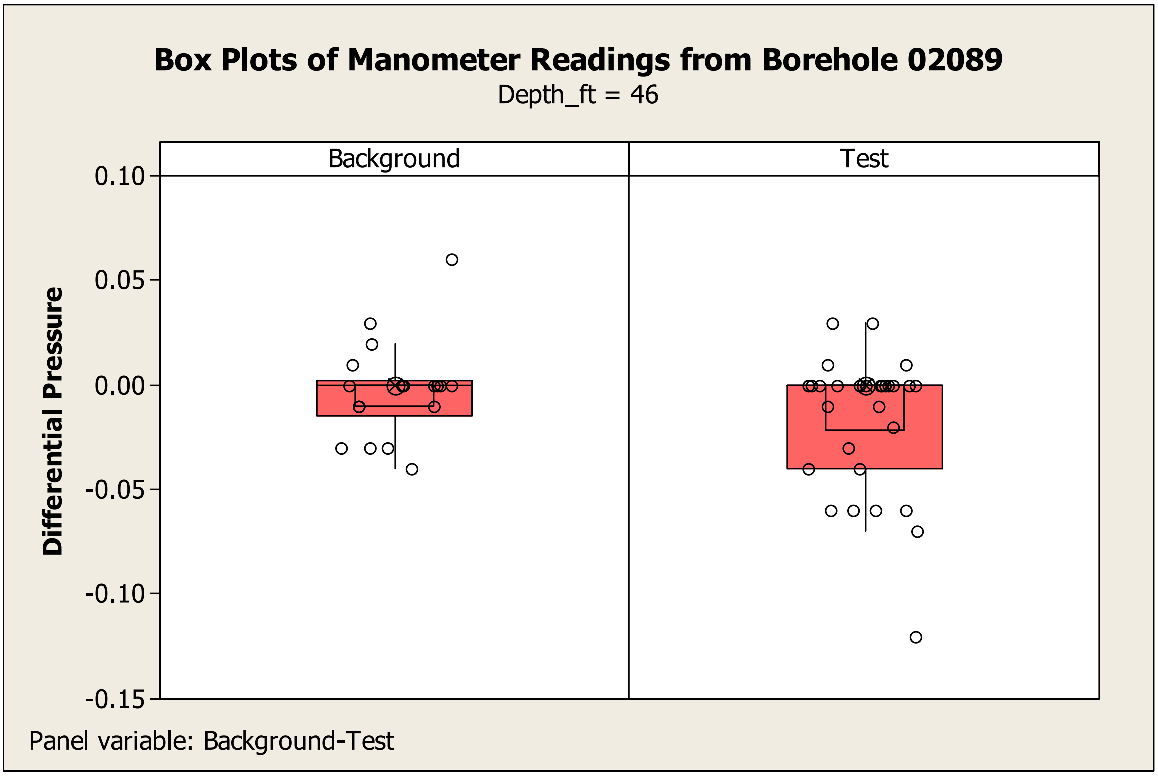


Box Plots of Manometer Readings from Borehole 02087
Depth_ft = 86
Background
Test
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
Panel variable: Background-Test

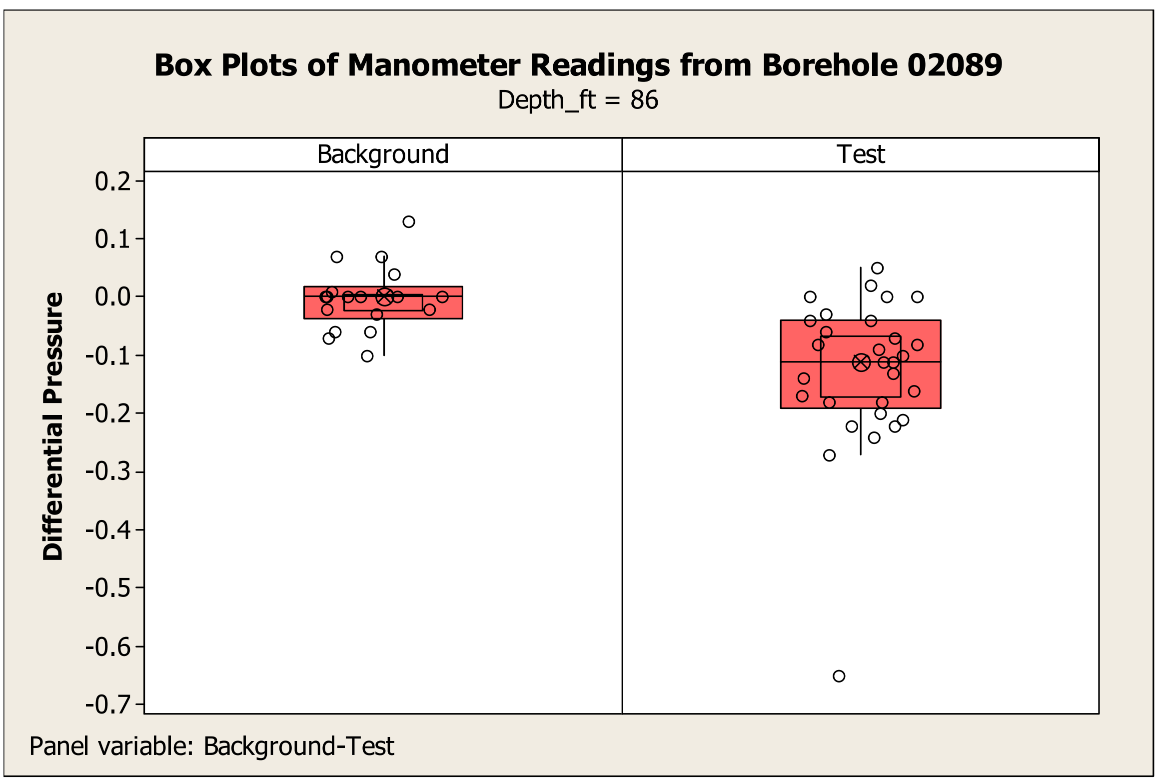
Boxplots of Manometer Readings from Borehole 54-02089





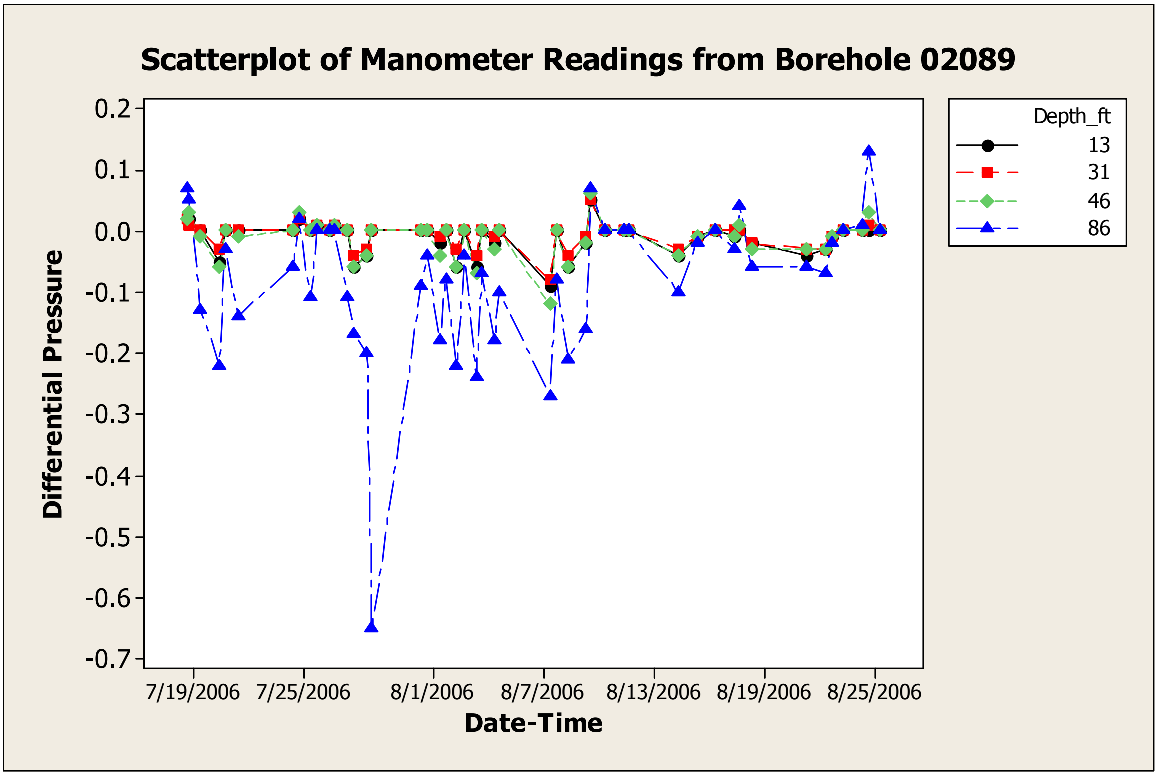


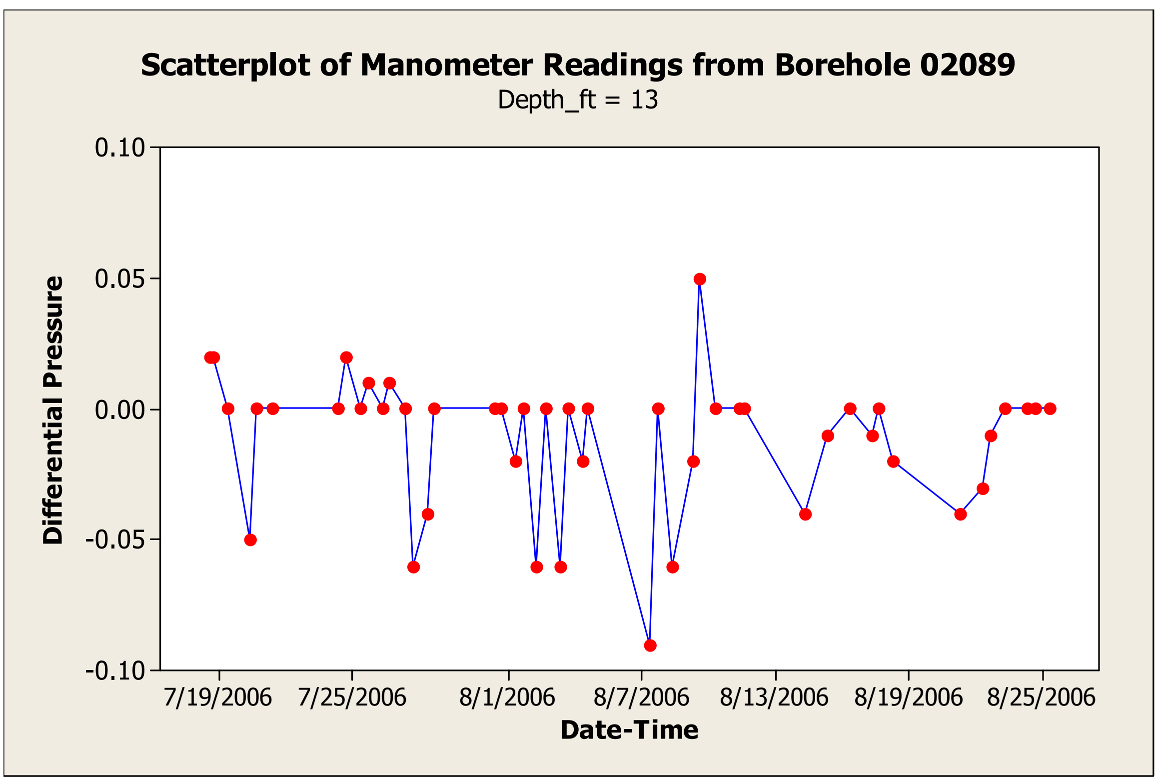
Box Plots of Manometer Readings from Borehole 02089
Depth_ft = 46
Background
Test
0.10
0.05
0.00
-0.05
-0.10
-0.15
Differential Pressure
Panel variable: Background-Test

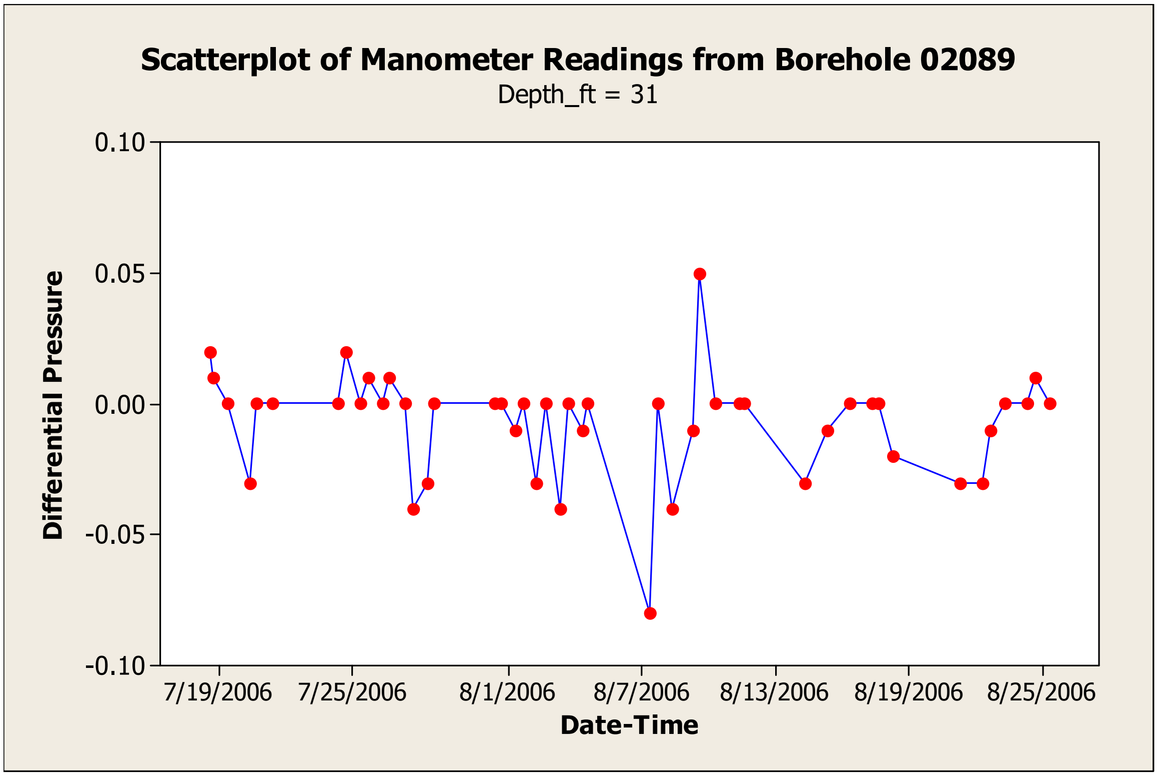


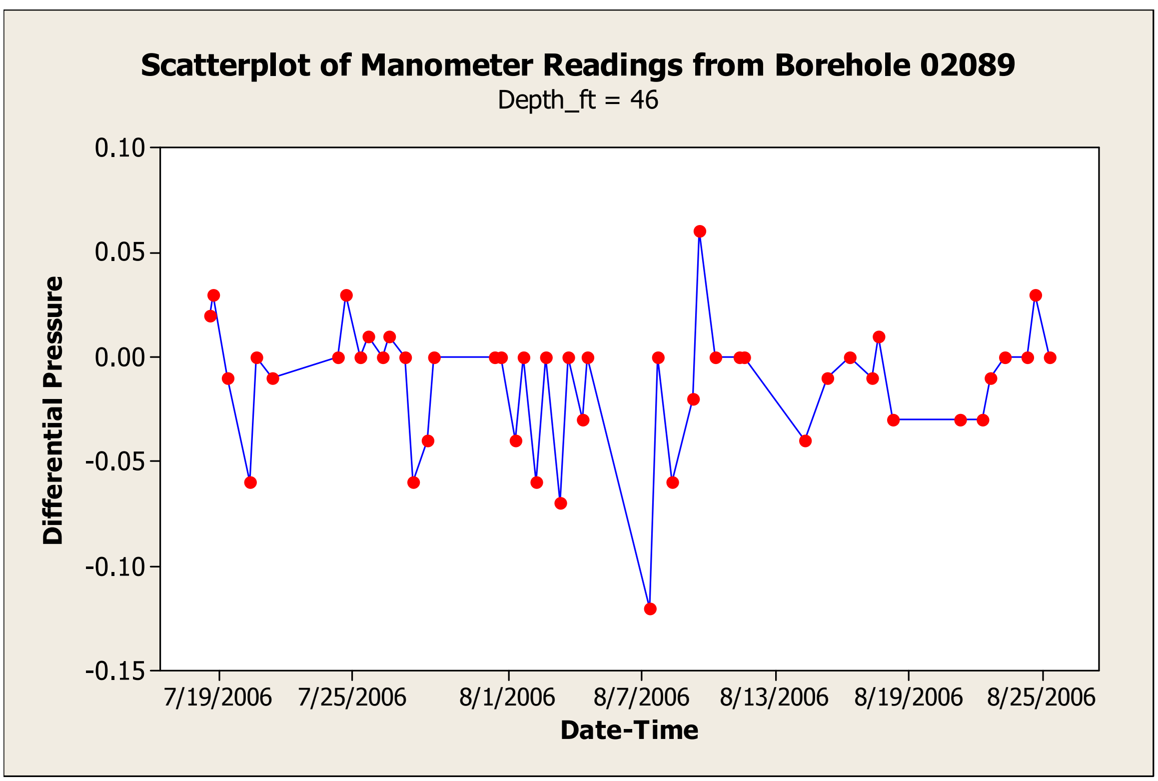
Box Plots of Manometer Readings from Borehole 02089
Depth_ft = 86
Background
Test
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
Differential Pressure
Panel variable: Background-Test

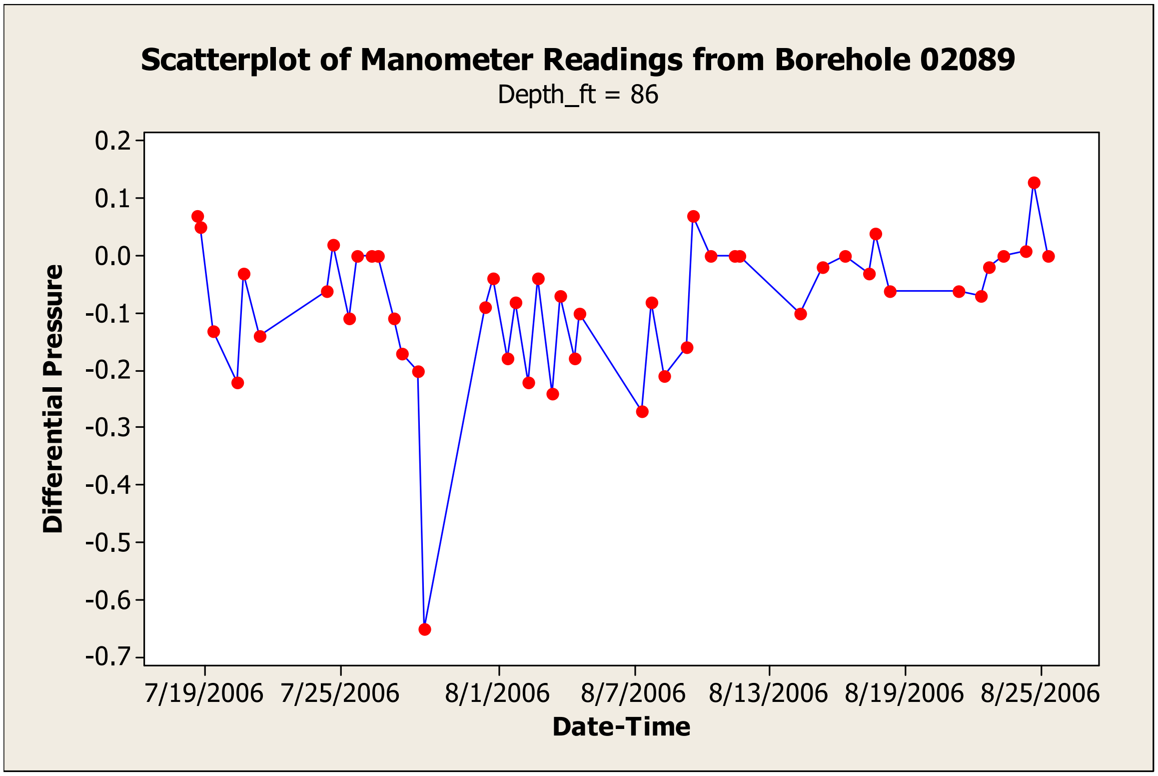
Scatterplots of Manometer Readings from Borehole 54-02089



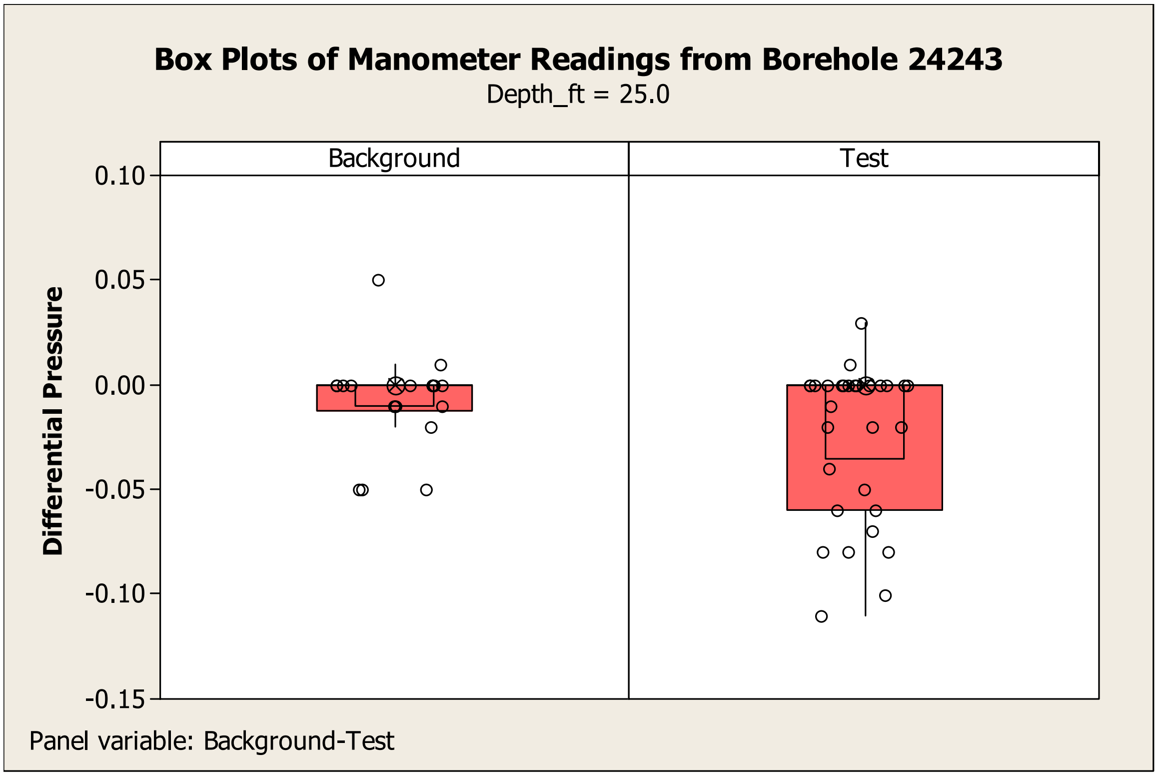


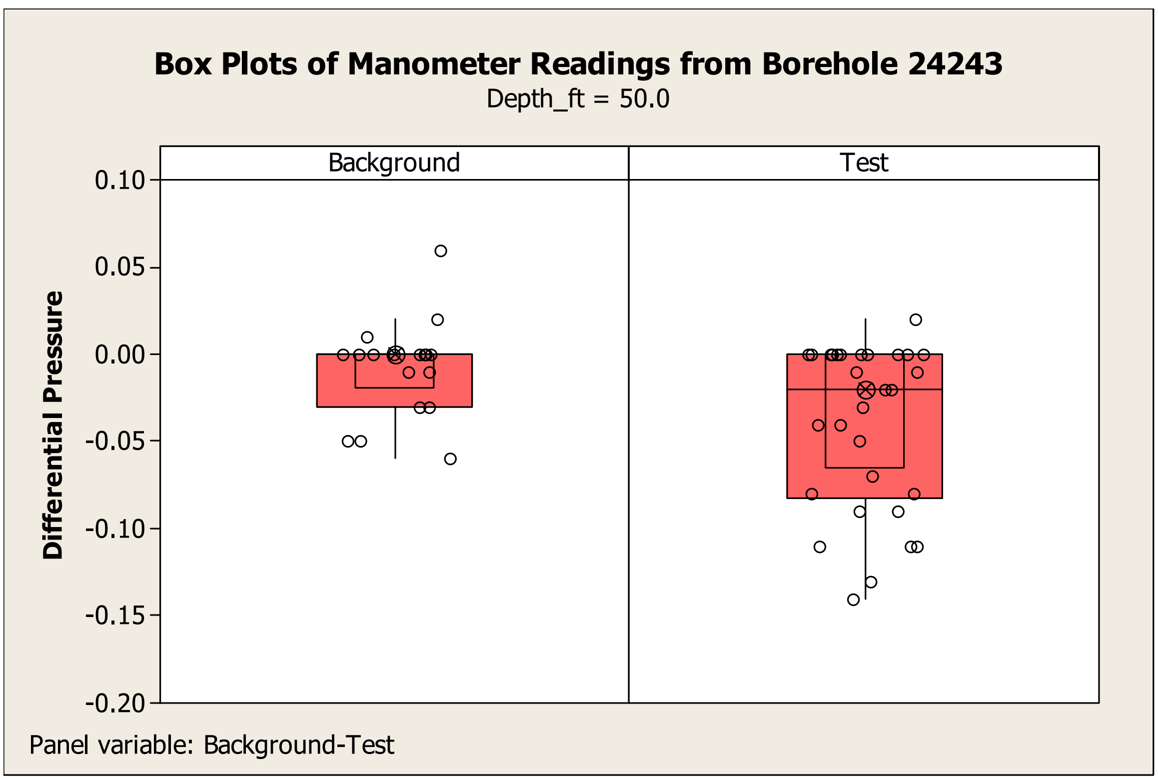

Scatterplot of Manometer Readings from Borehole 02089
Depth_ft = 31
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

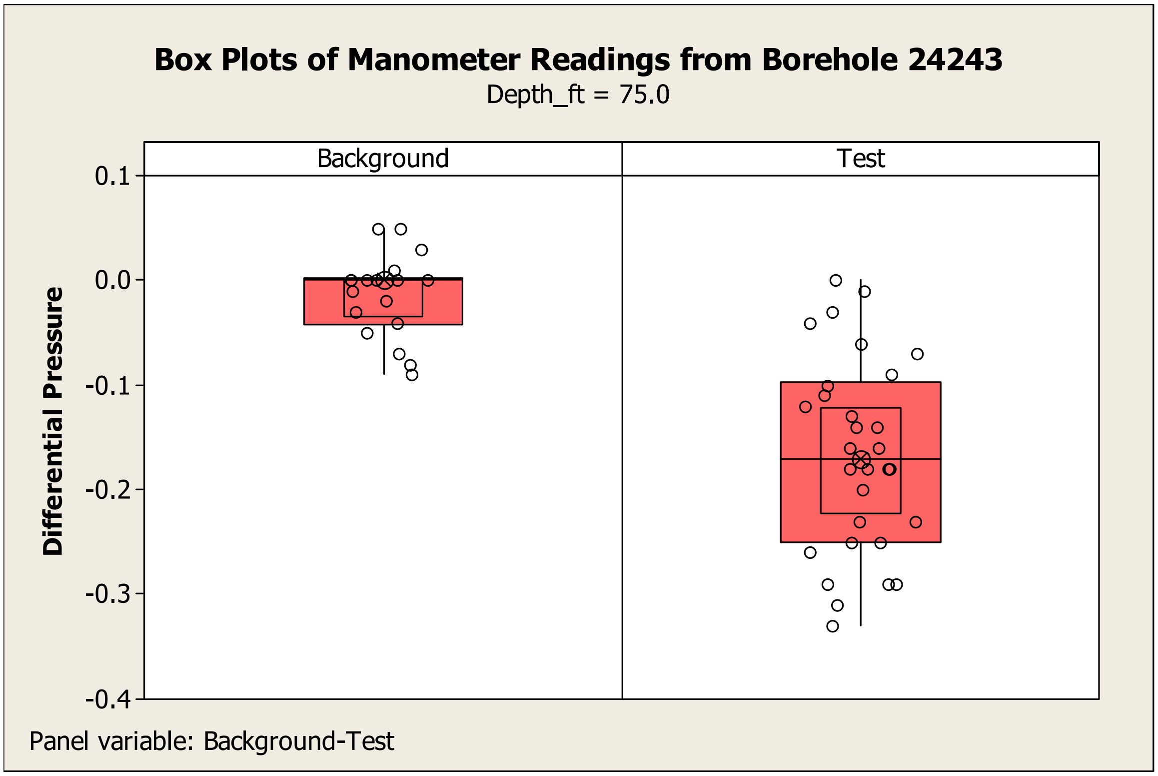

Scatterplot of Manometer Readings from Borehole 02089
Depth_ft = 46
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

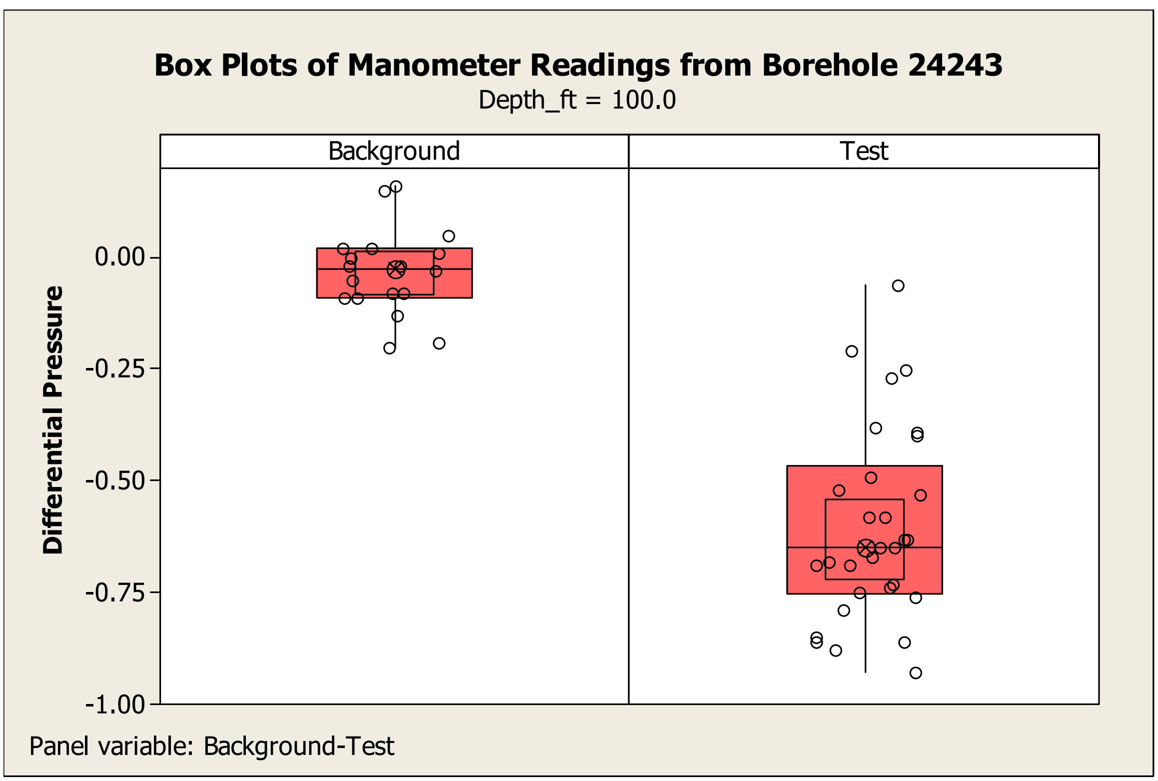

Scatterplot of Manometer Readings from Borehole 02089
Depth_ft = 86
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

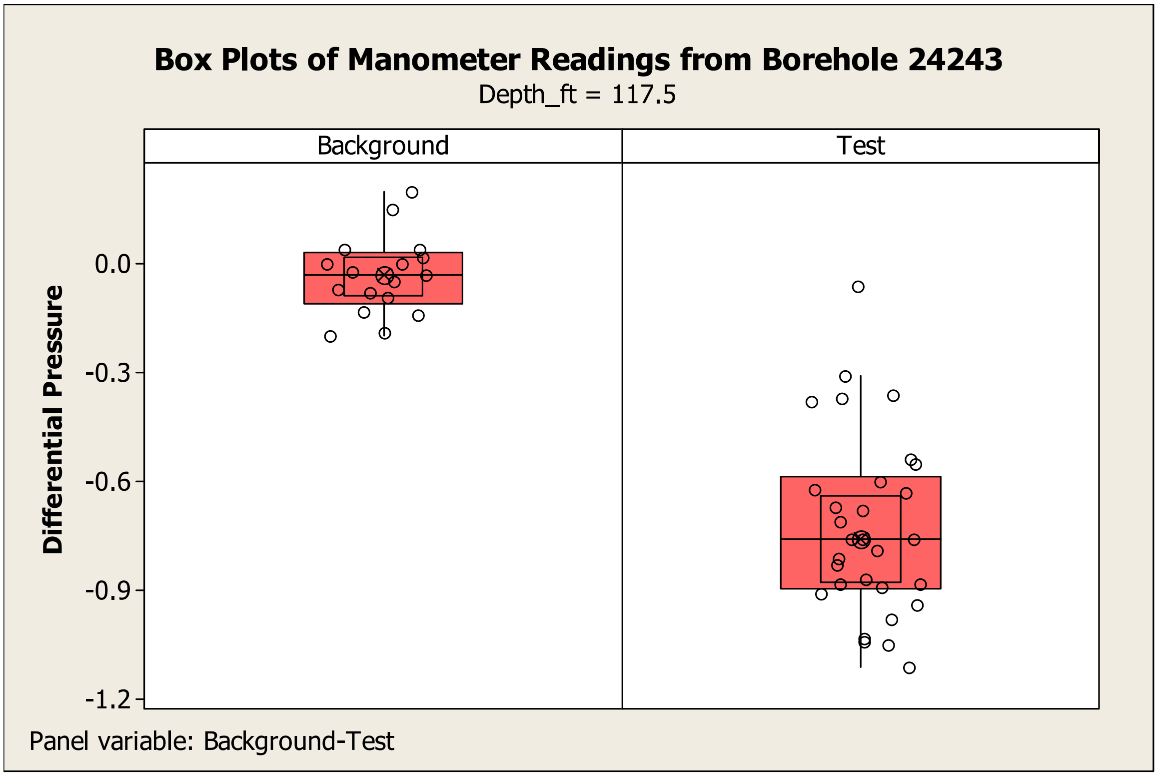
Boxplots of Manometer Readings from Borehole 54-24243



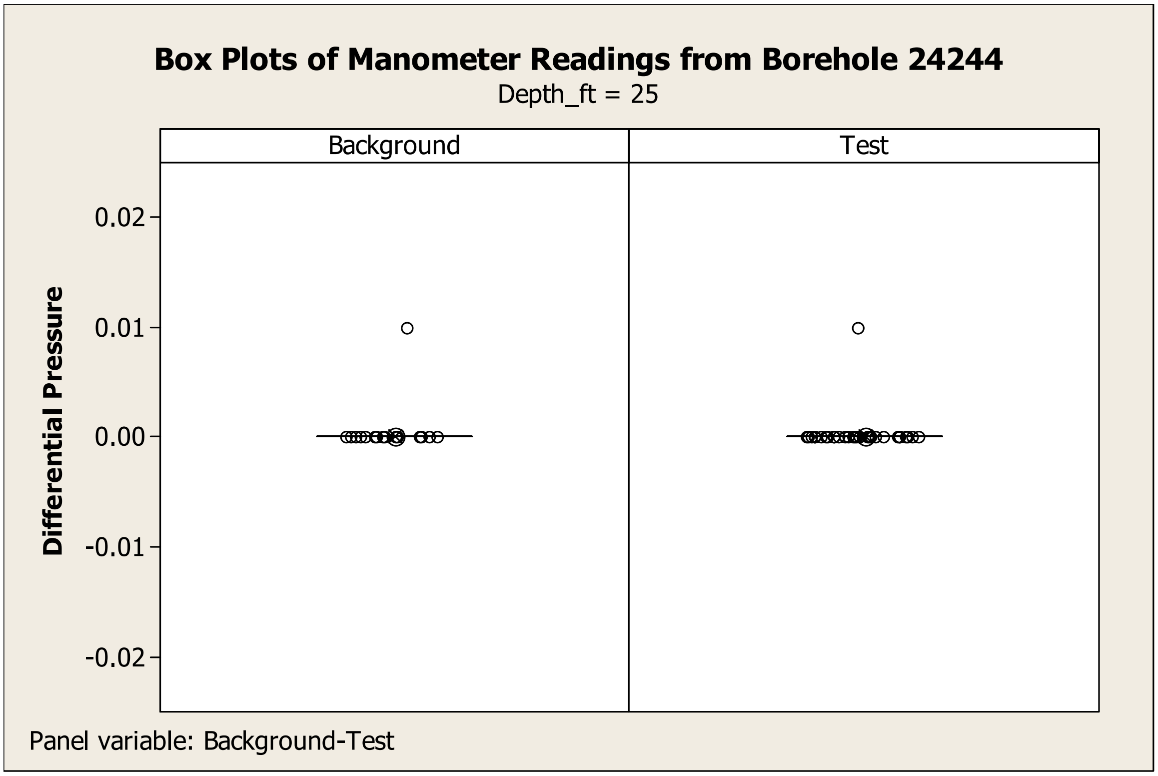


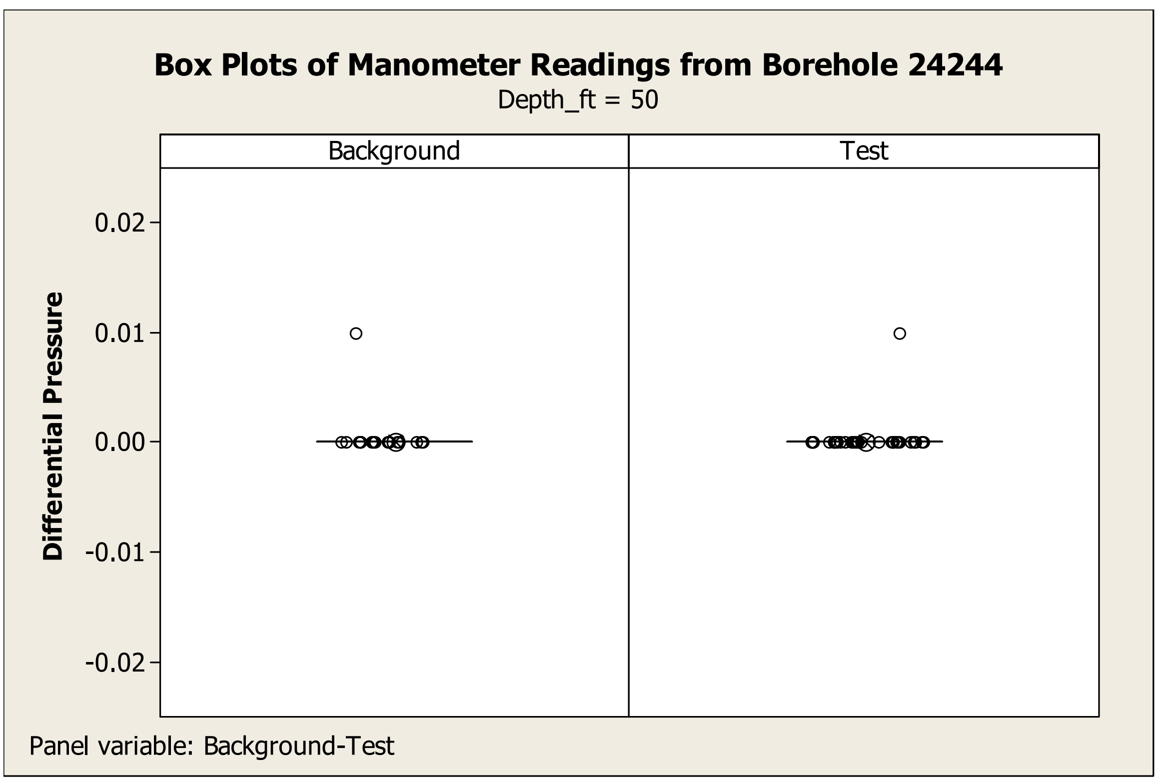

Box Plots of Manometer Readings from Borehole 24243
Depth_ft = 75.0
Background
Test
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Panel variable: Background-Test

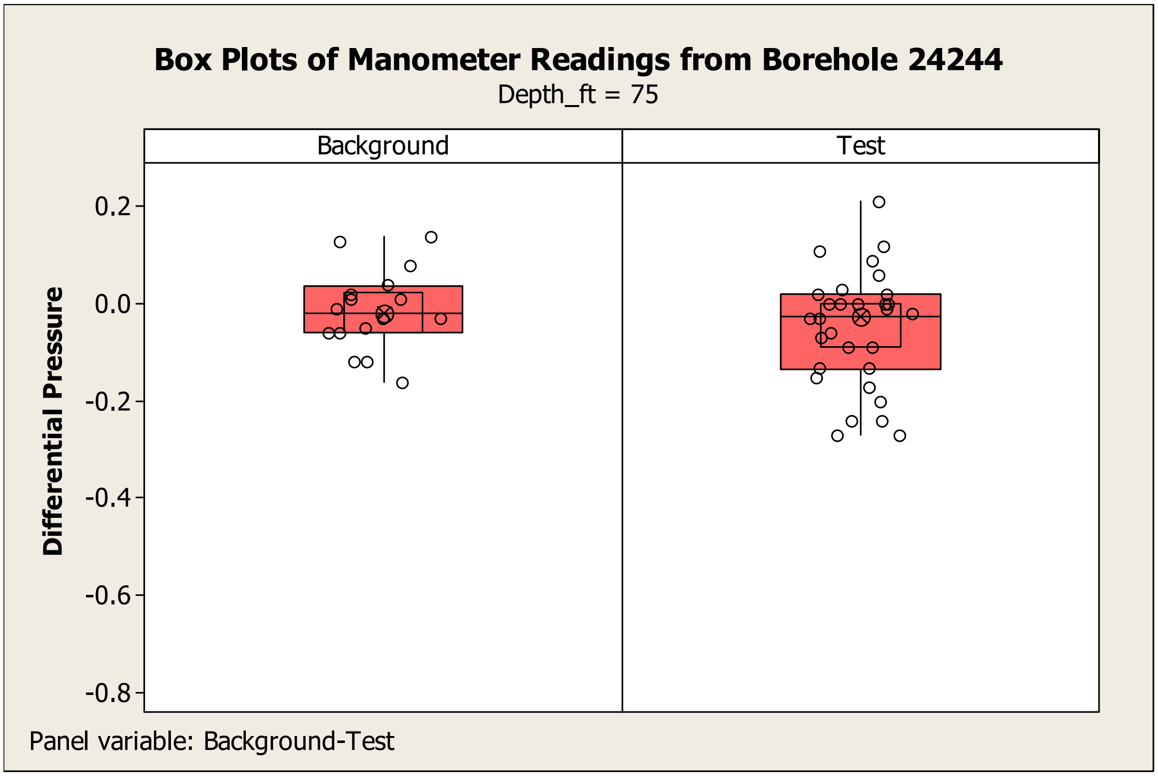

Box Plots of Manometer Readings from Borehole 24243
Depth_ft = 100.0
Background
Test
Differential Pressure
0.00
-0.25
-0.50
-0.75
-1.00
Panel variable: Background-Test


Box Plots of Manometer Readings from Borehole 24243
Depth_ft = 117.5
Background
Test
Differential Pressure
0.0
-0.3
-0.6
-0.9
-1.2
Panel variable: Background-Test

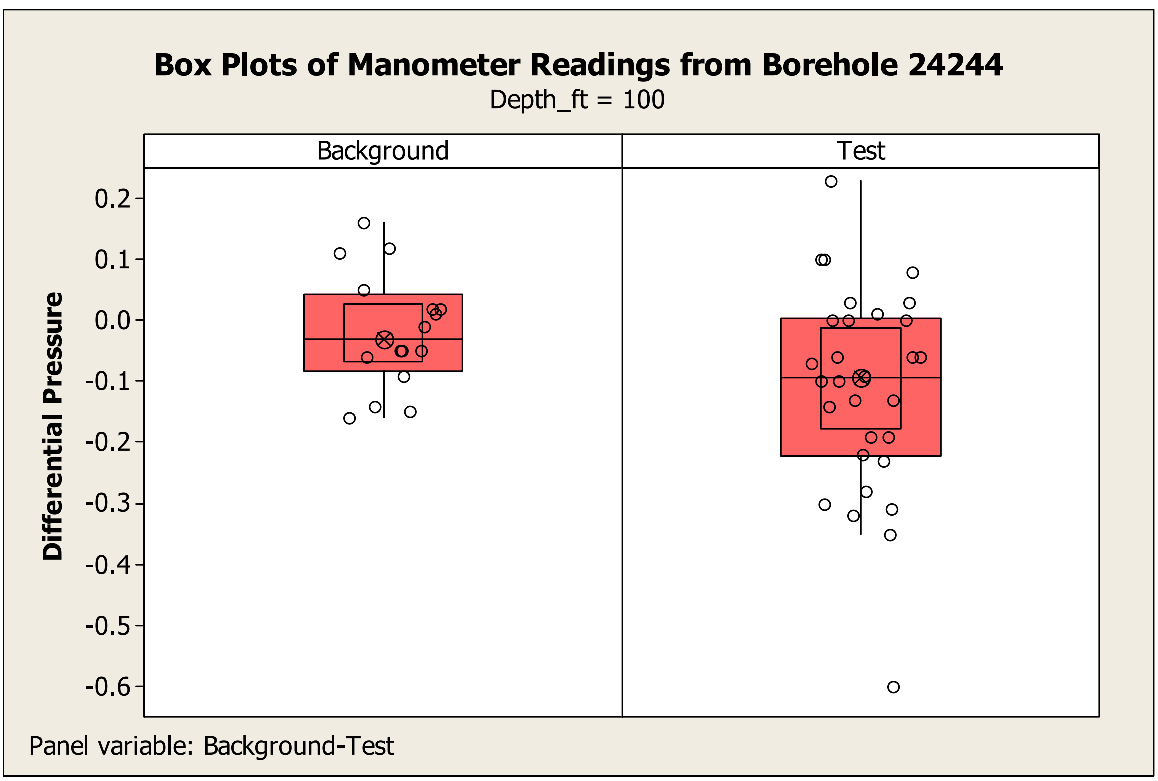
Boxplots of Manometer Readings from Borehole 54-24244



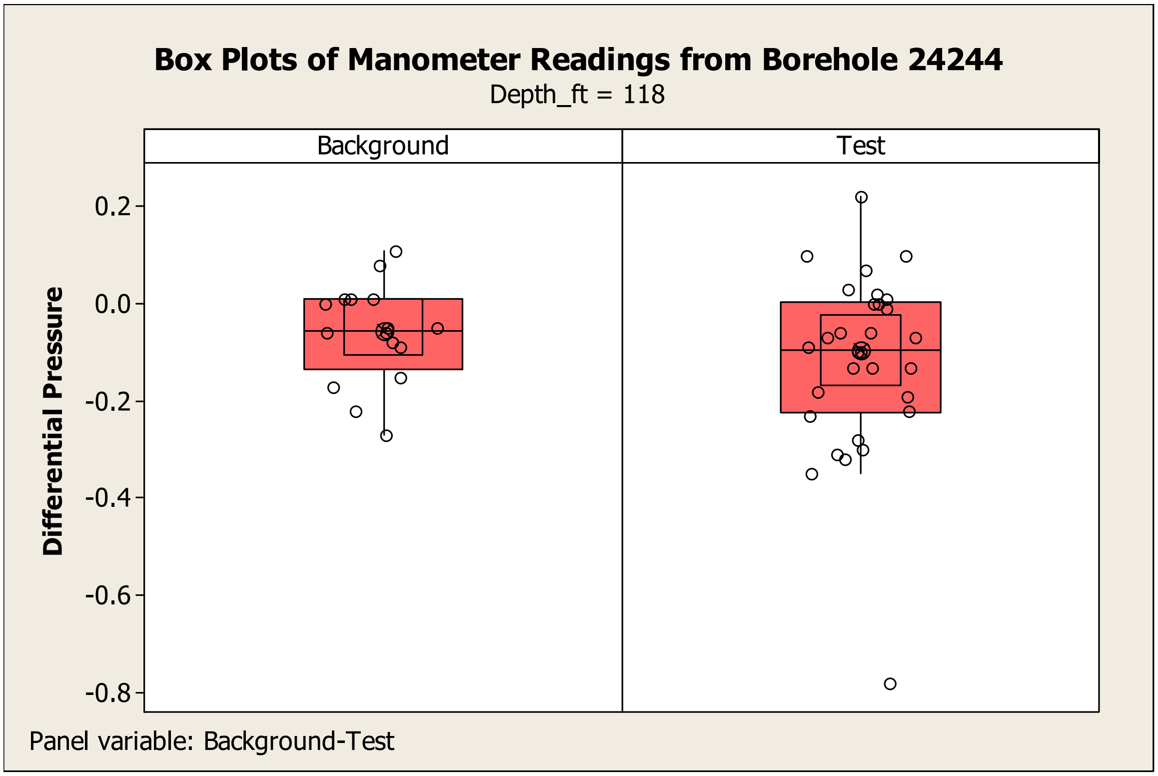




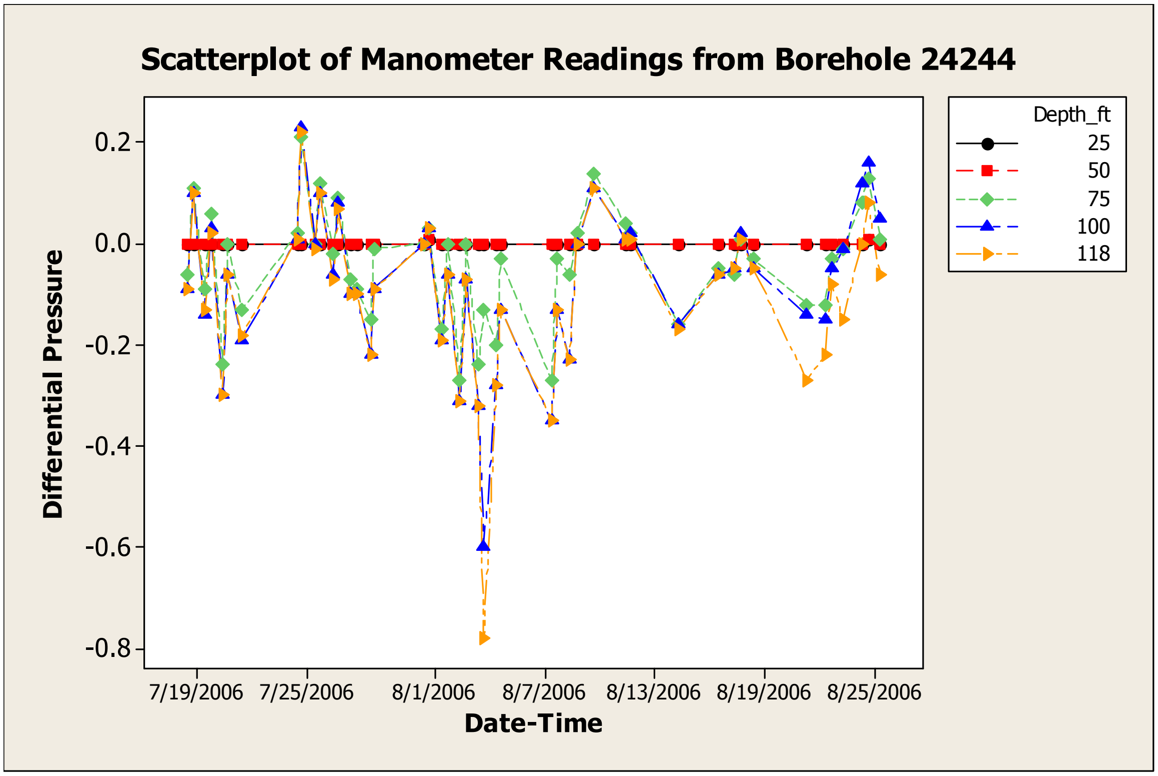
Box Plots of Manometer Readings from Borehole 24244
Depth_ft = 75
Background
Test
Differential Pressure
0.2
0.0
-0.2
-0.4
-0.6
-0.8
Panel variable: Background-Test

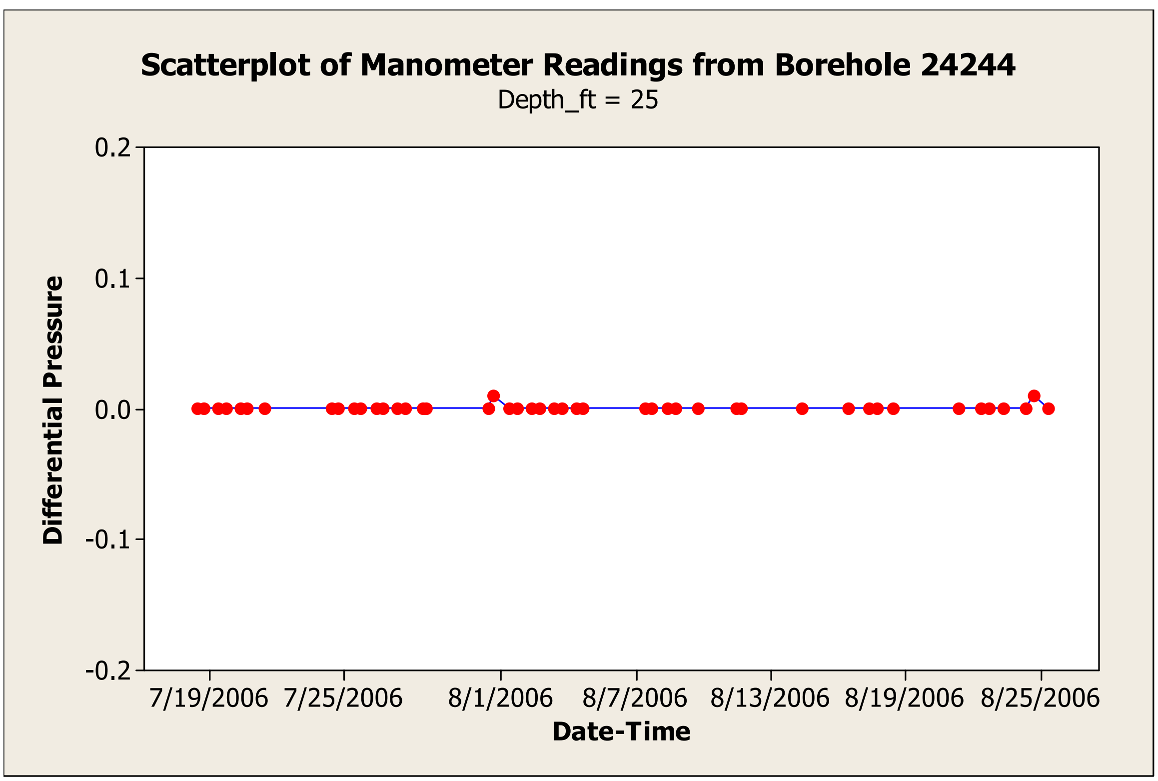


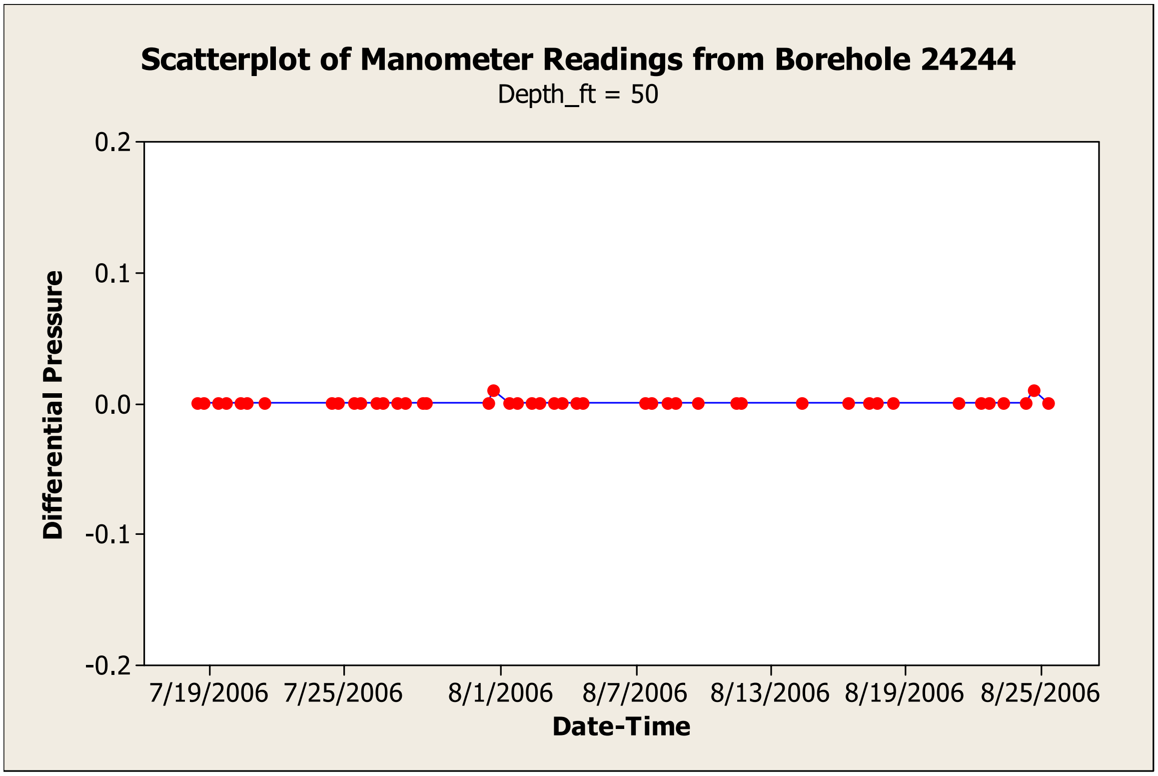
Box Plots of Manometer Readings from Borehole 24244
Depth_ft = 100
Background
Test
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Panel variable: Background-Test

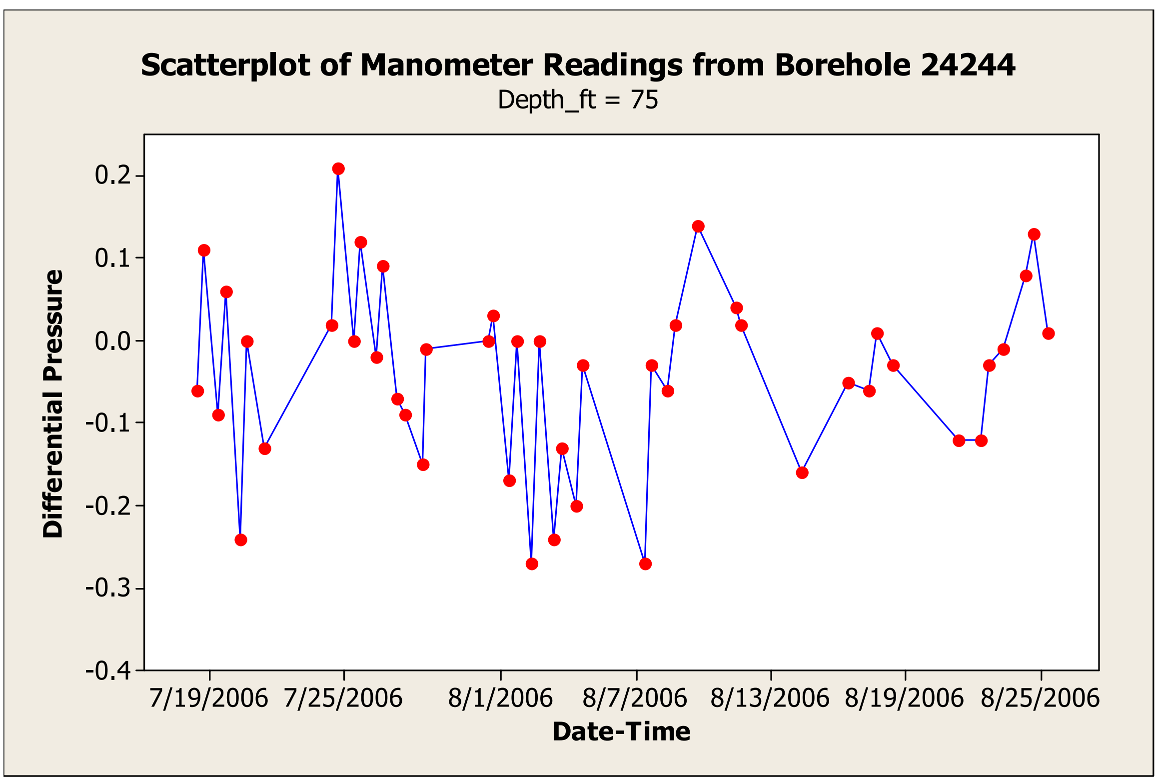

Box Plots of Manometer Readings from Borehole 24244
Depth_ft = 118
Background
Test
Differential Pressure
0.2
0.0
-0.2
-0.4
-0.6
-0.8
Panel variable: Background-Test

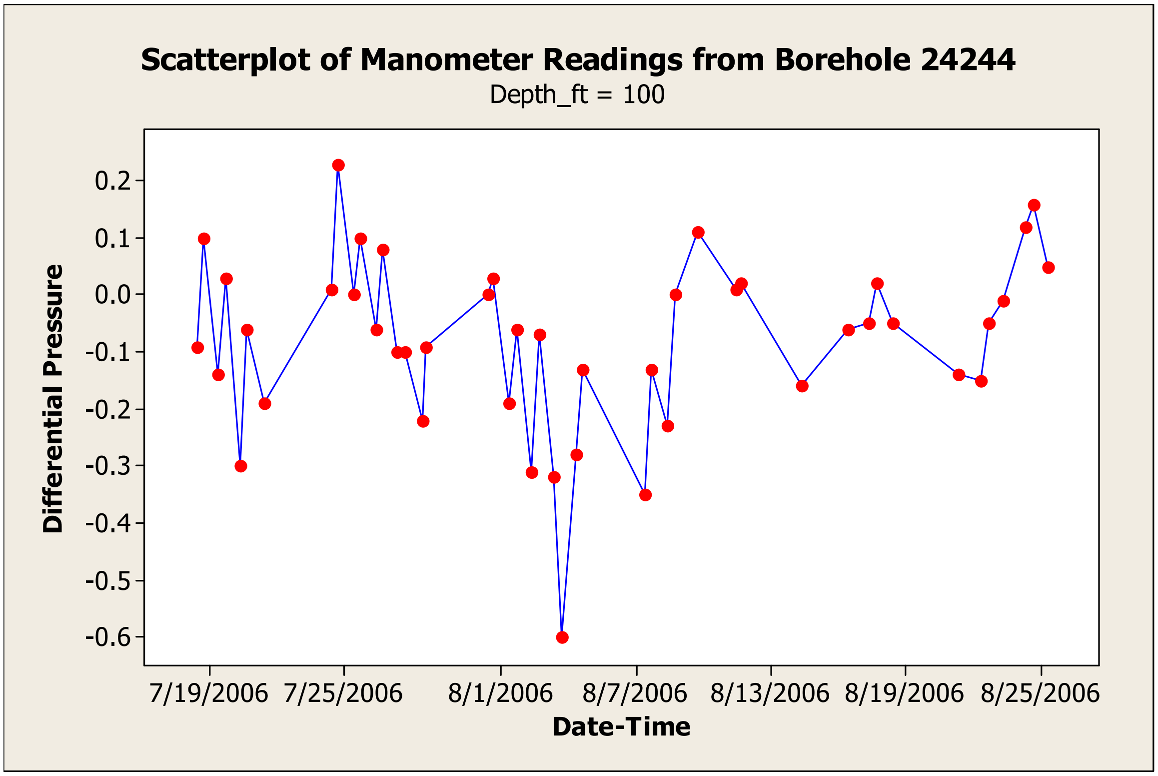
Scatterplots of Manometer Readings from Borehole 54-24244

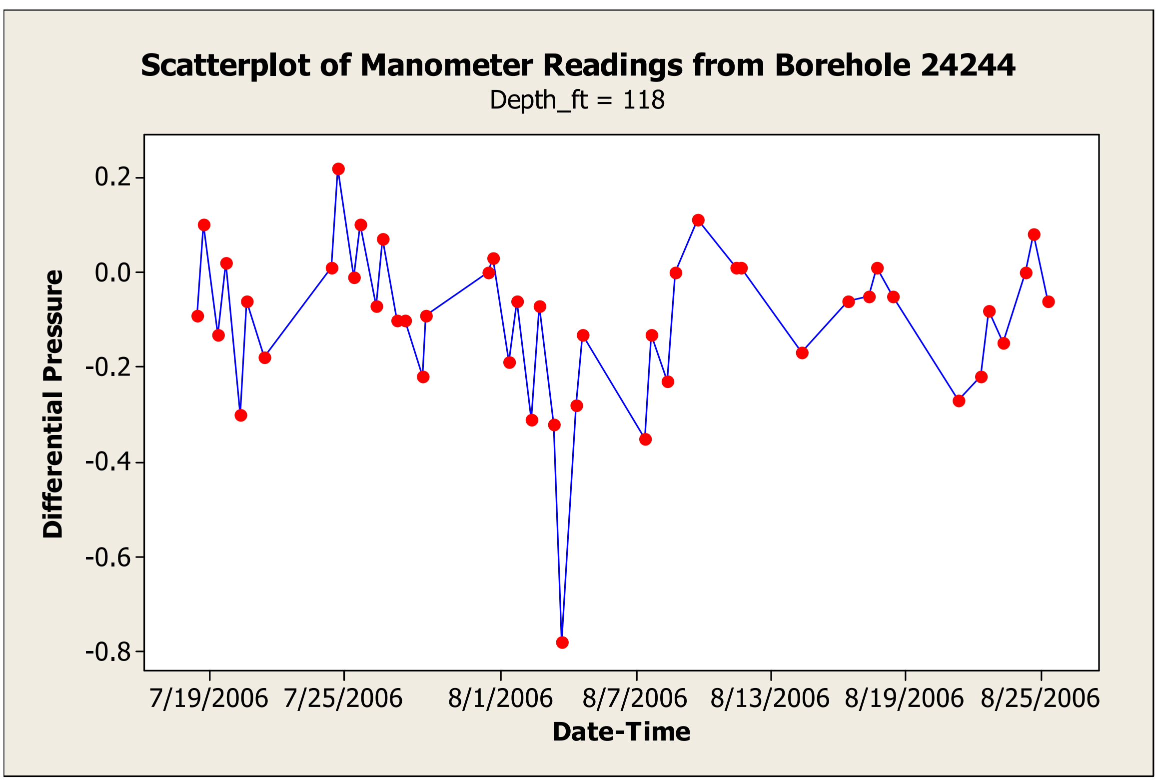




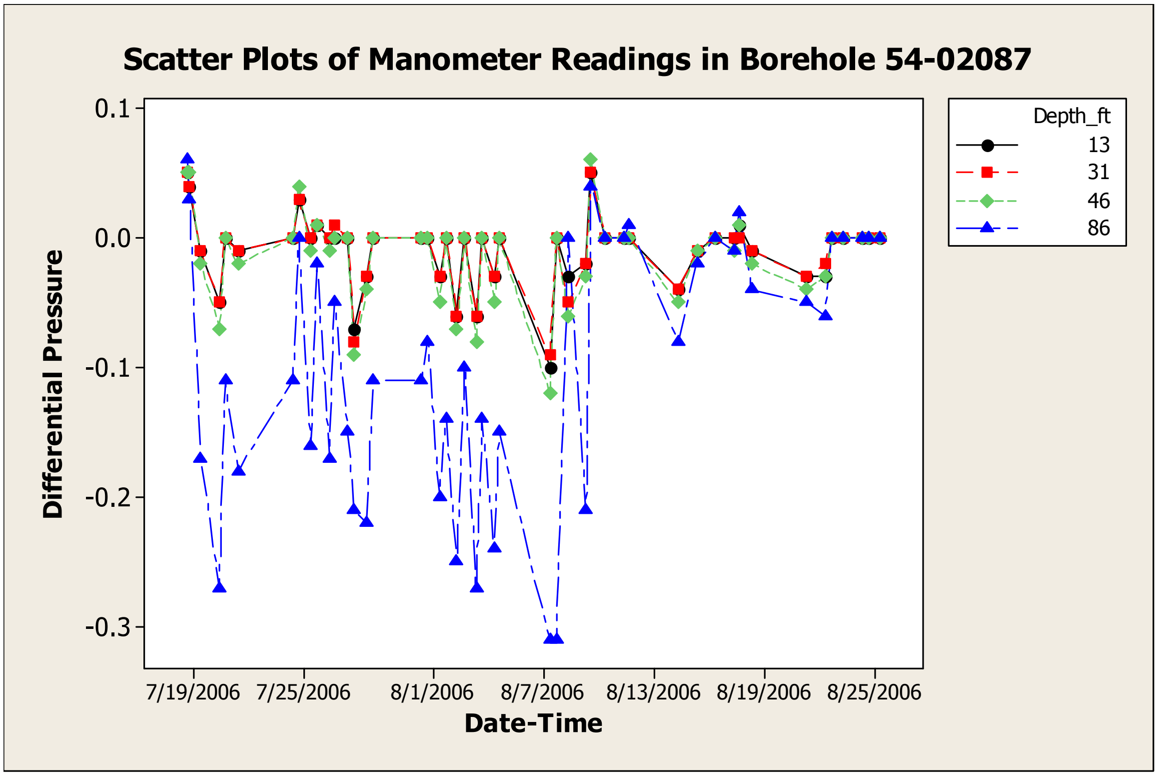

Scatterplot of Manometer Readings from Borehole 24244
Depth_ft = 50
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

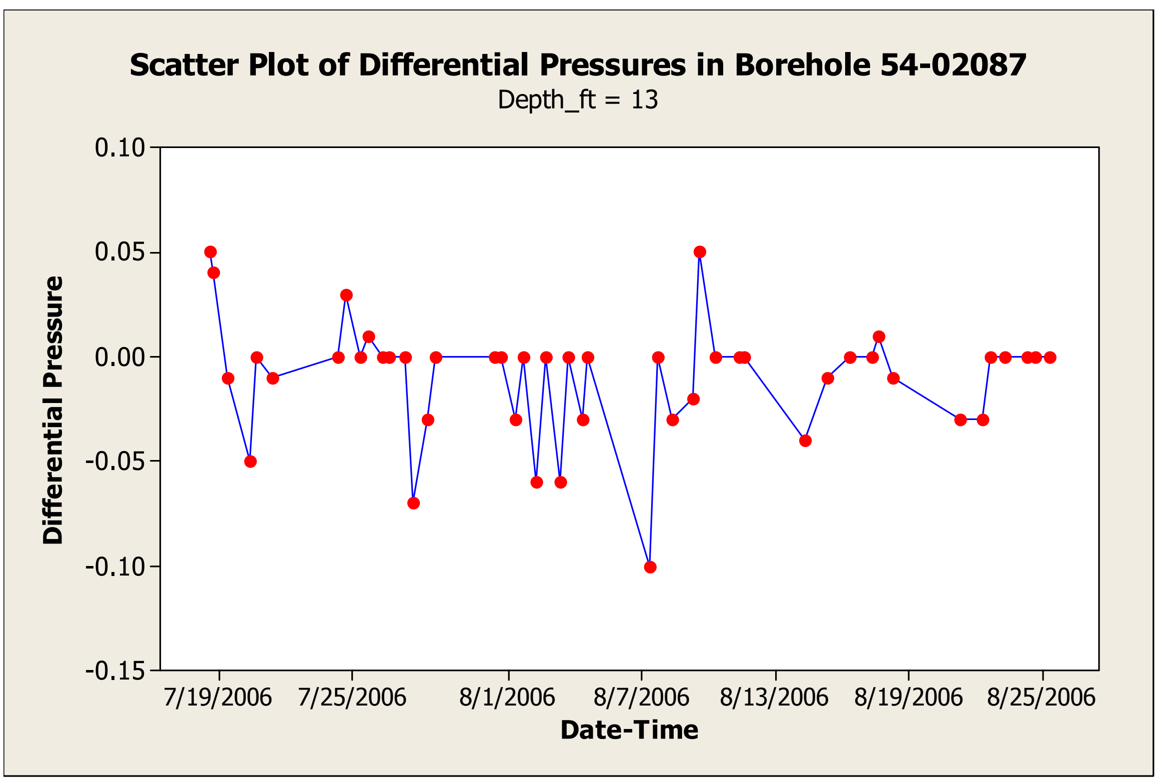

Scatterplot of Manometer Readings from Borehole 24244
Depth_ft = 75
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

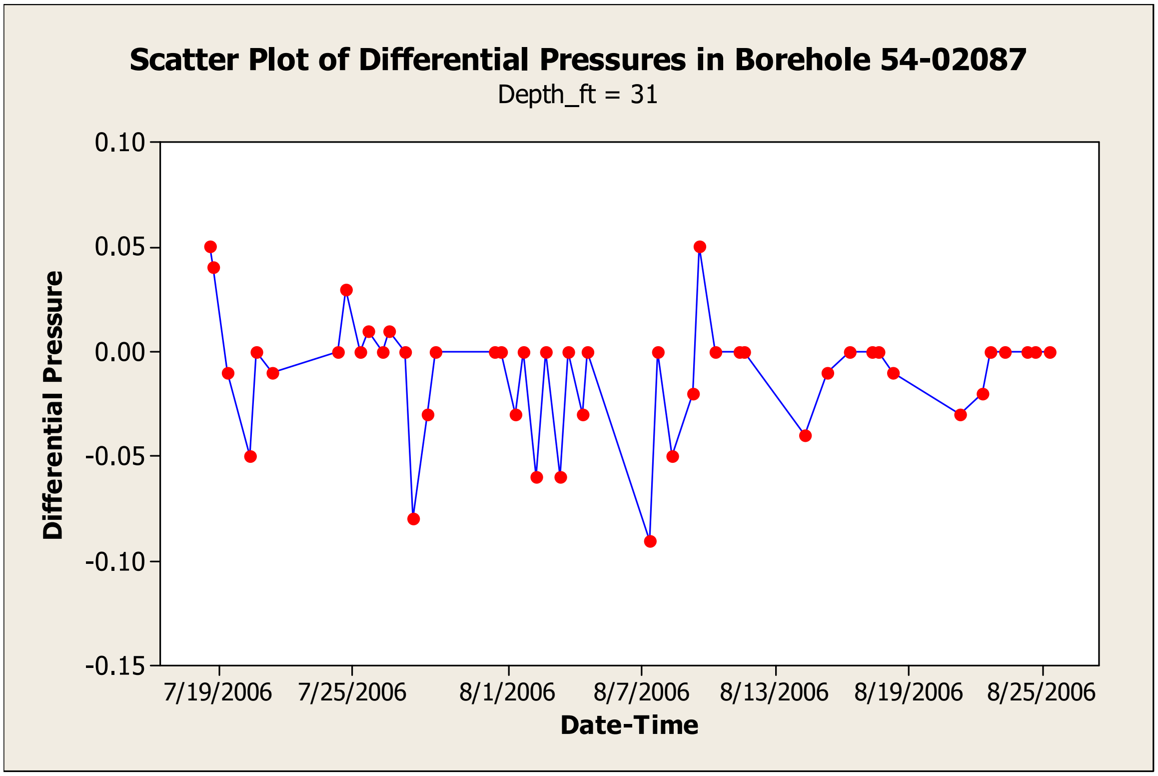

Scatterplot of Manometer Readings from Borehole 24244
Depth_ft = 100
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

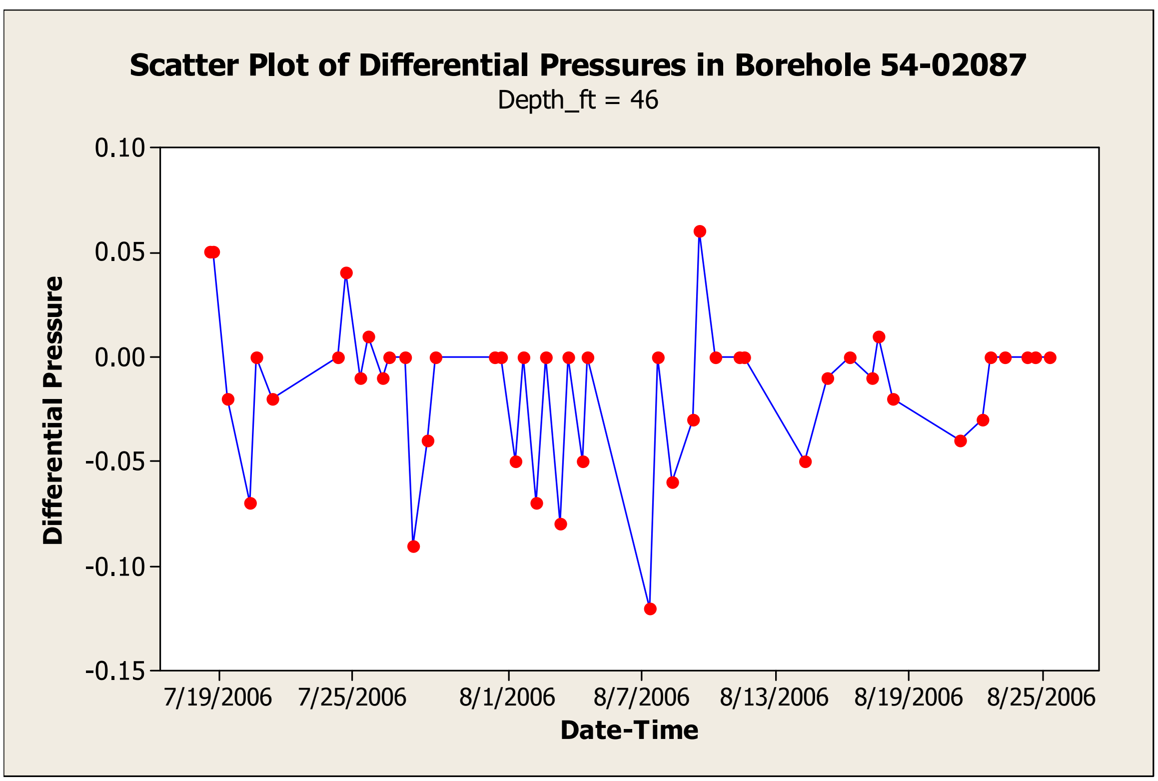

Scatterplot of Manometer Readings from Borehole 24244
Depth_ft = 118
Differential Pressure
0.2
0.0
-0.2
-0.4
-0.6
-0.8
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

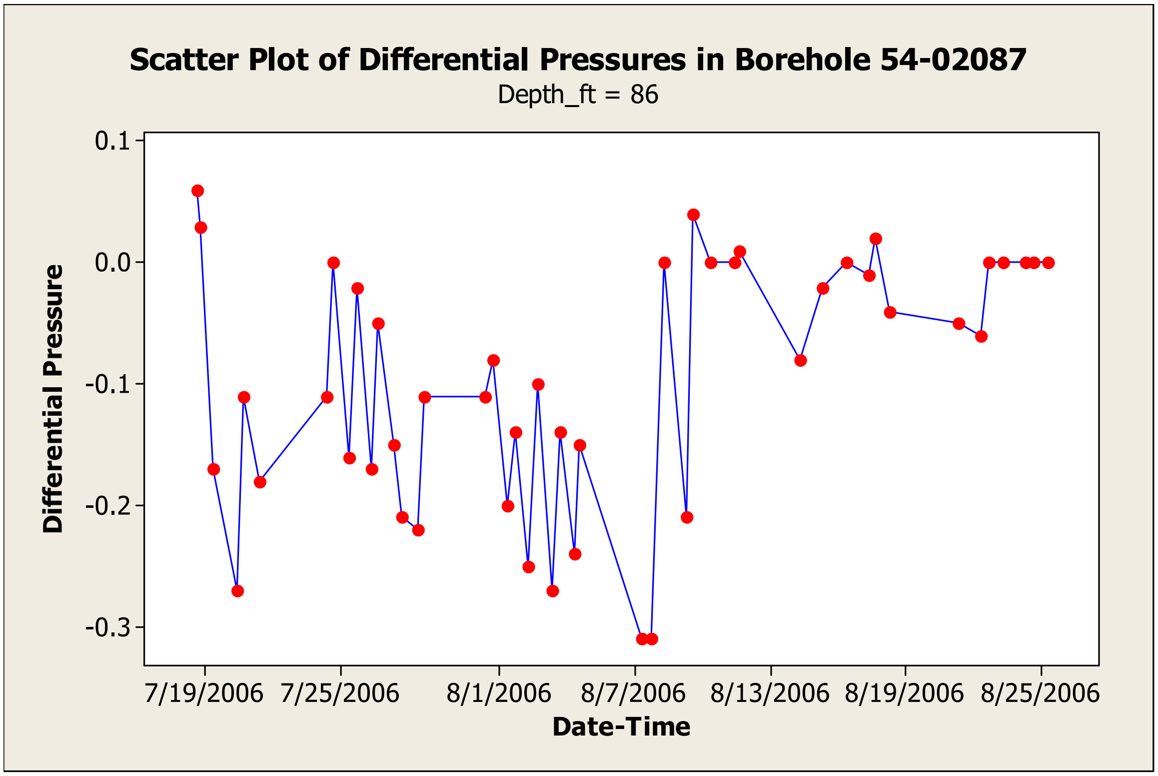
Scatterplots of Manometer in Borehole 54-02087



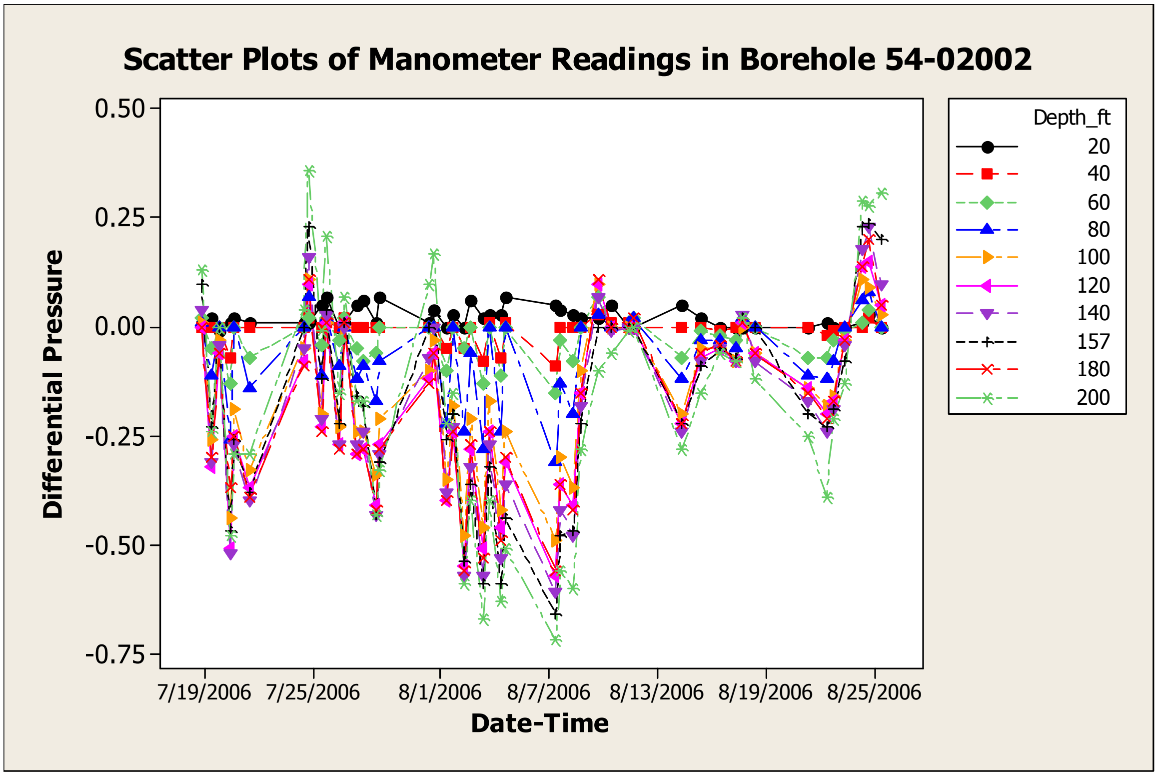


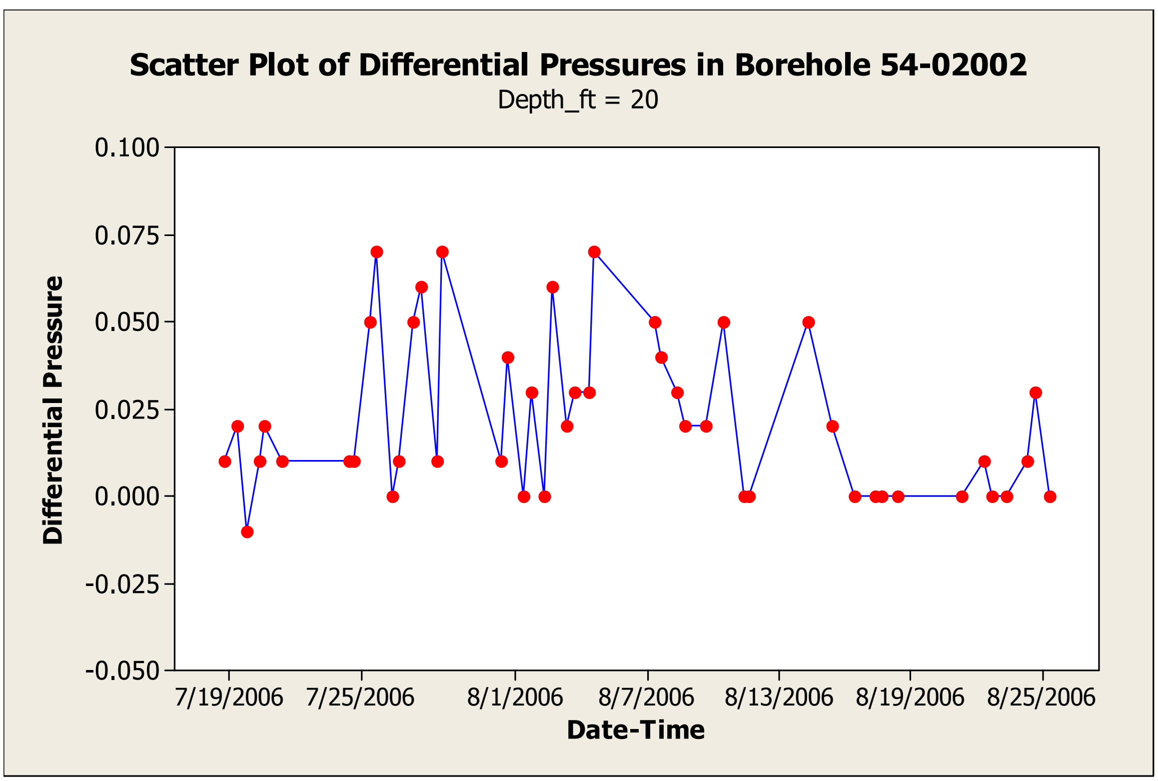

Scatter Plot of Differential Pressures in Borehole 54-02087
Depth_ft = 31
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

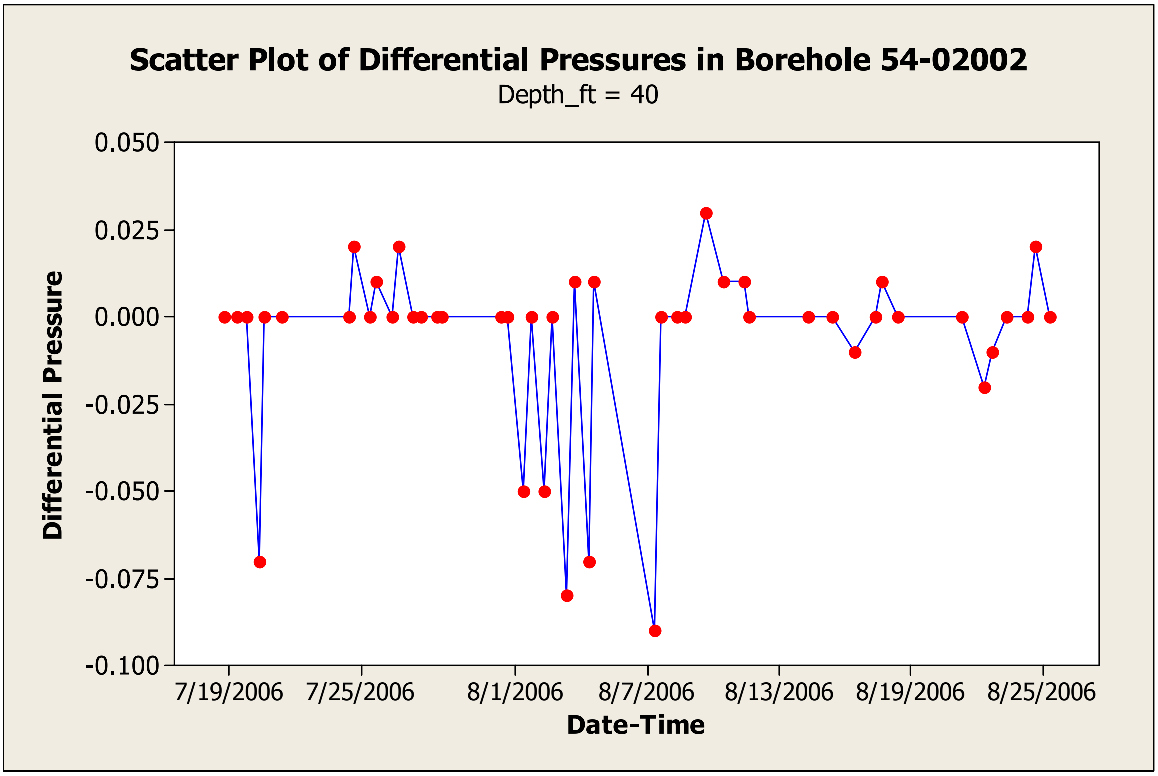

Scatter Plot of Differential Pressures in Borehole 54-02087
Depth_ft = 46
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

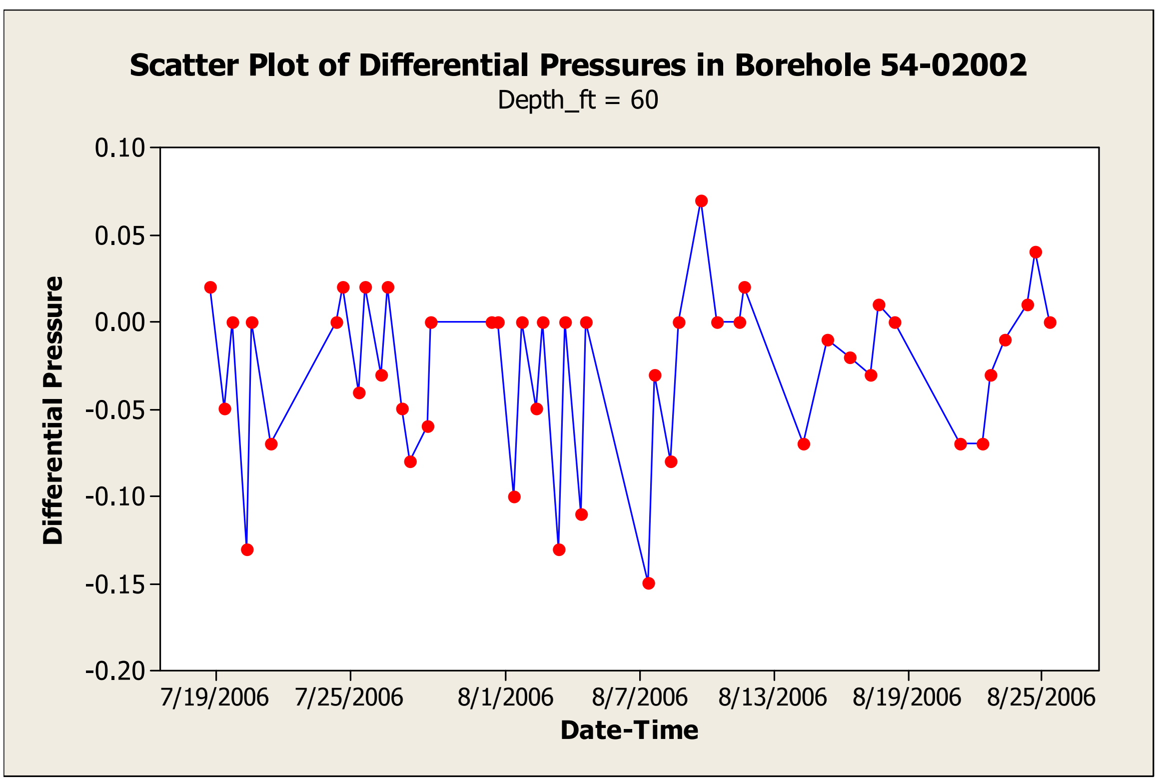

Scatter Plot of Differential Pressures in Borehole 54-02087
Depth_ft = 86
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

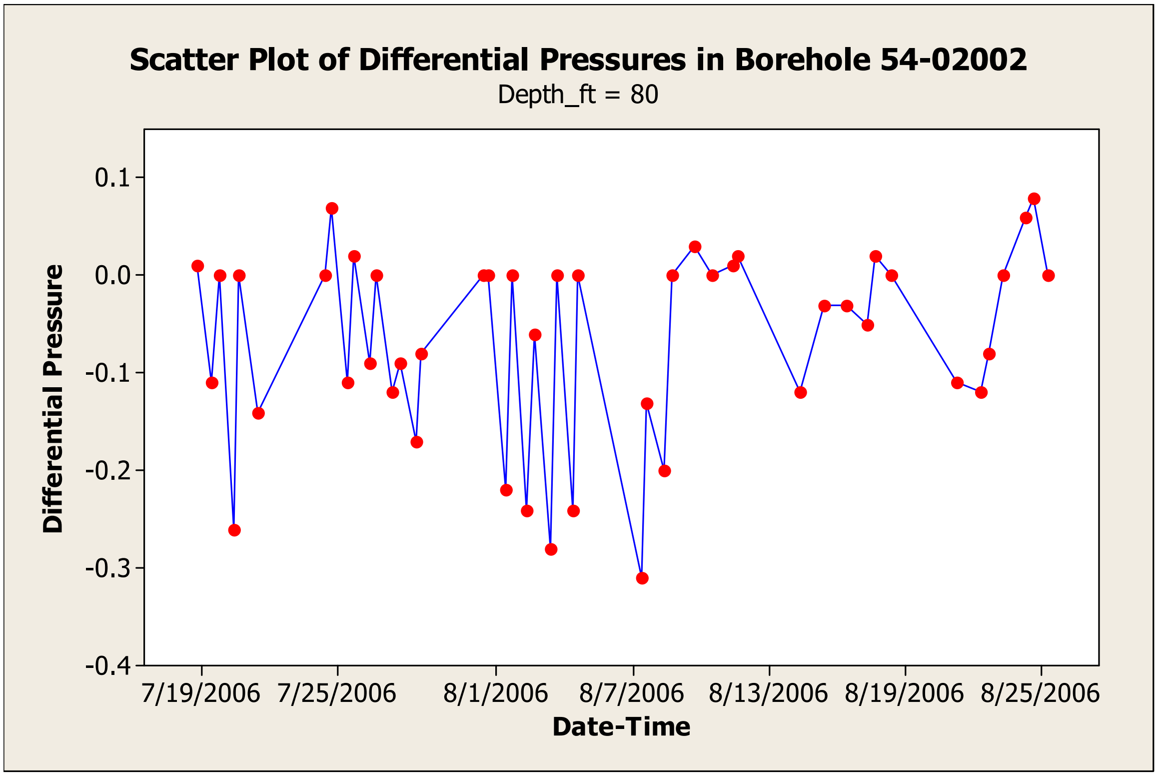
Scatterplots of Manometer Readings for Borehole 54-02002

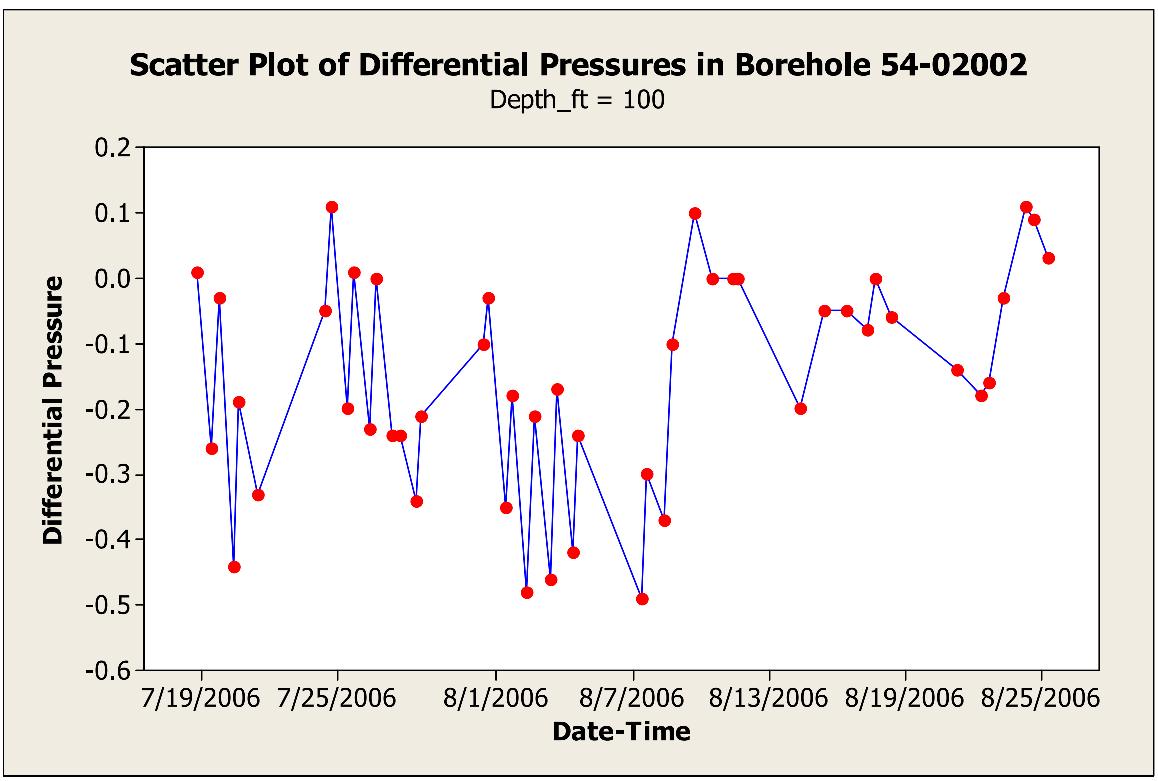


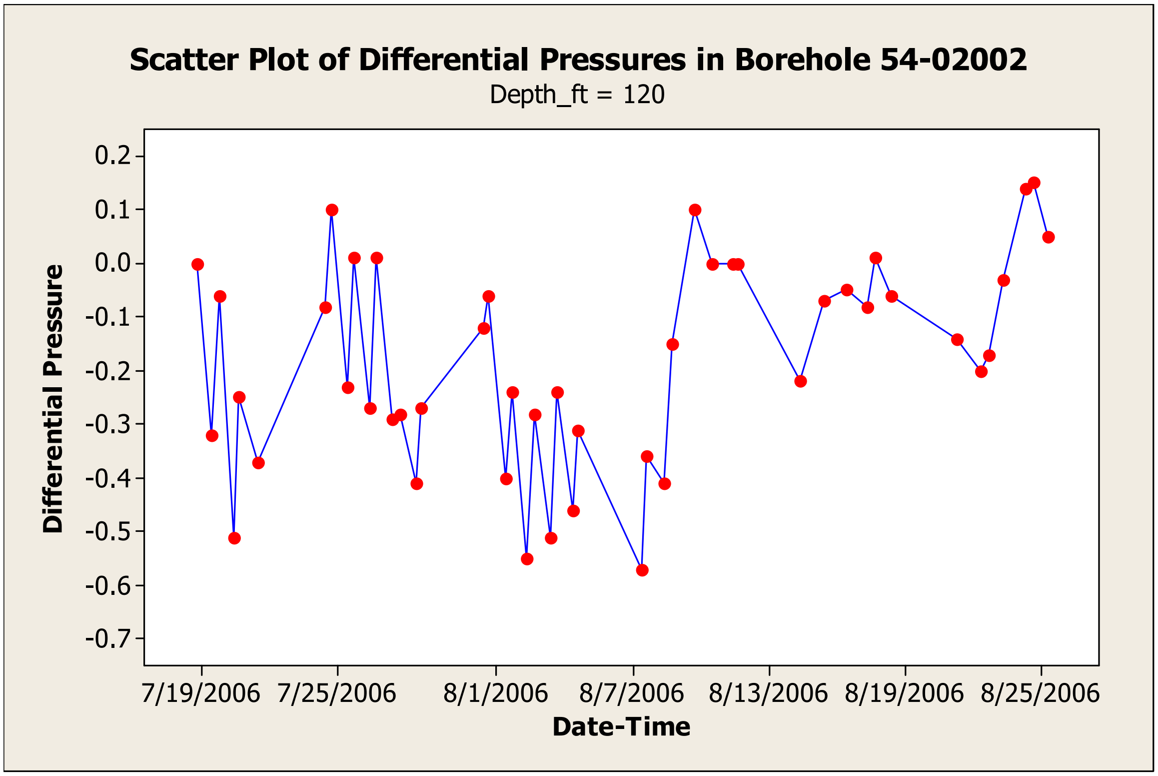


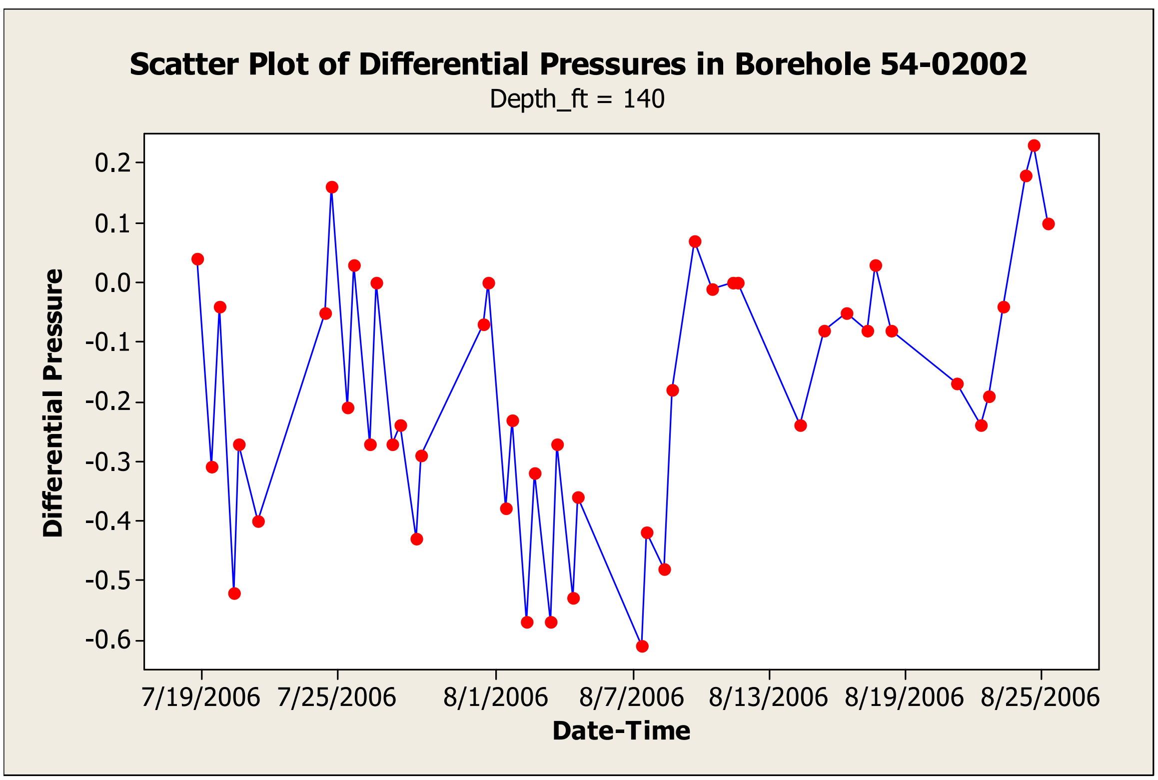

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 40
0.050
0.025
0.000
-0.025
-0.050
-0.075
-0.100
Differential Pressure
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

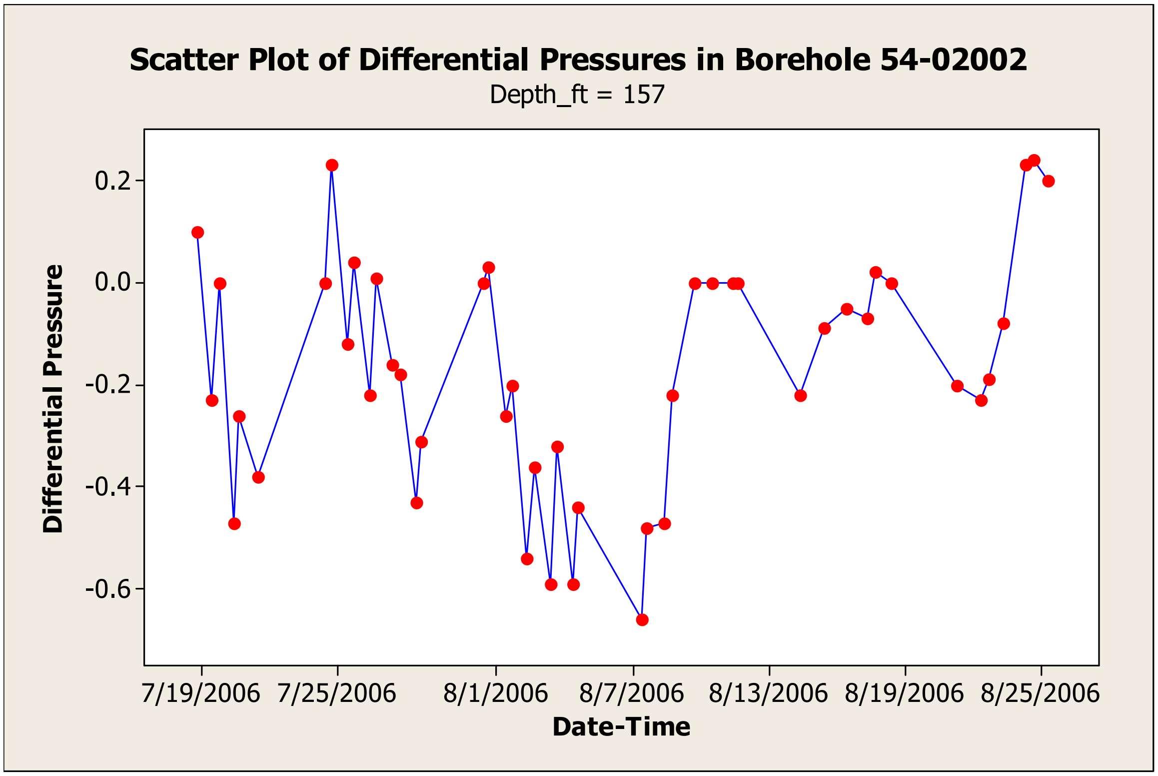

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 60
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
Differential Pressure
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

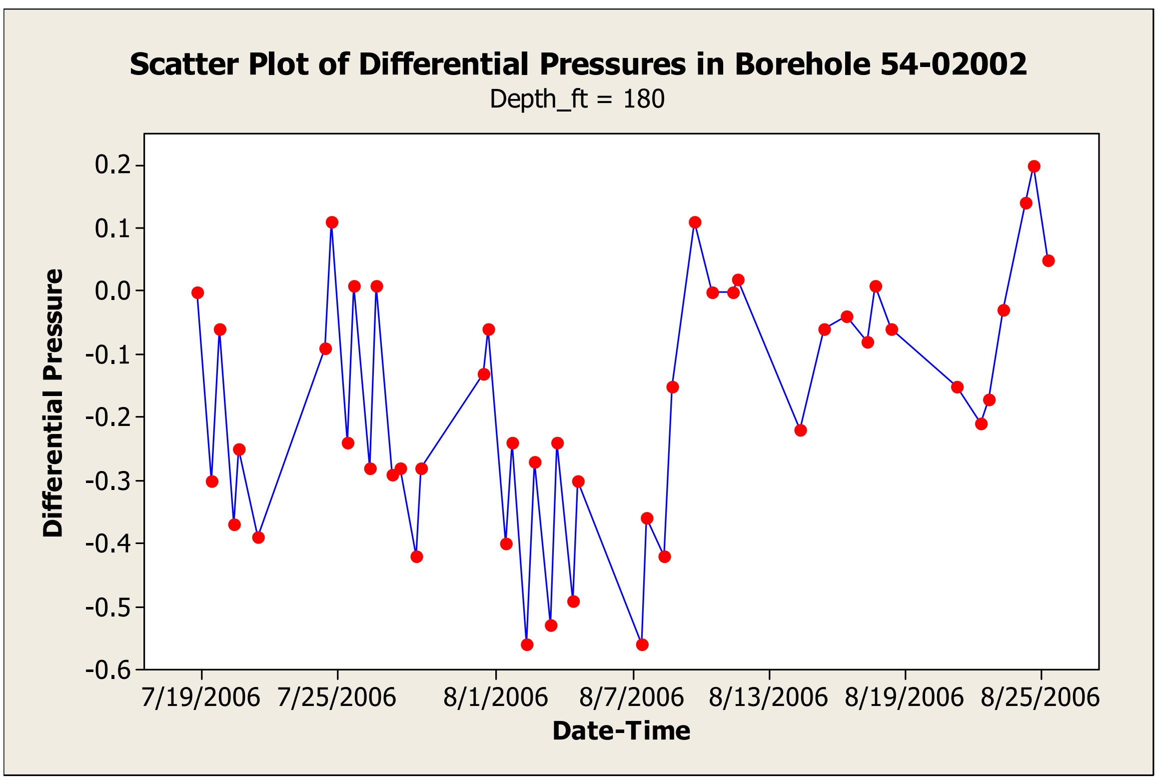

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 80
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

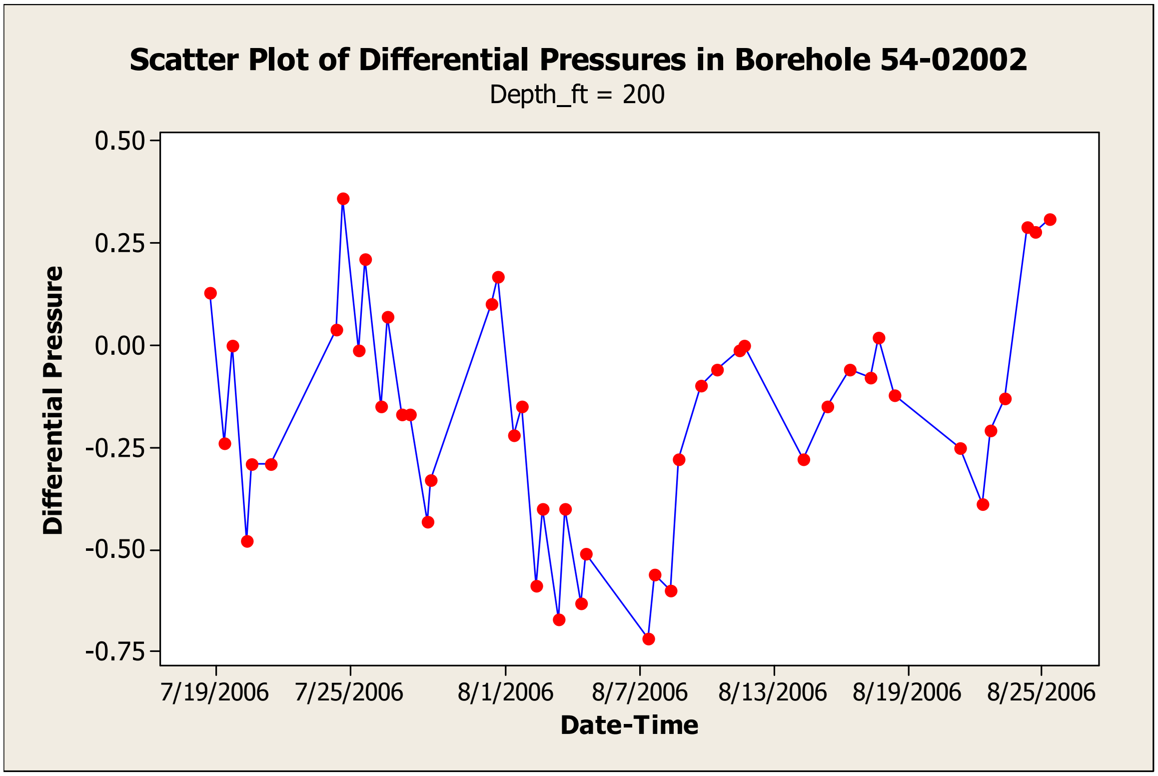

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 100
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time


Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 120
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

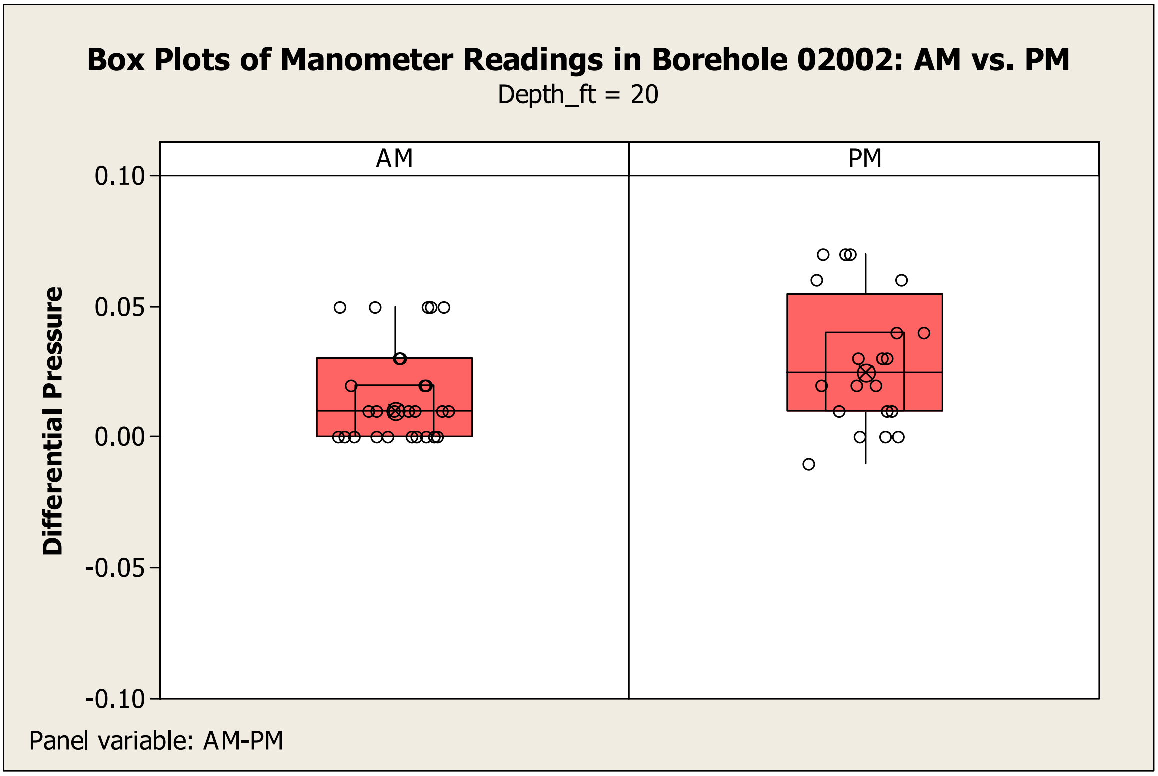

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 140
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

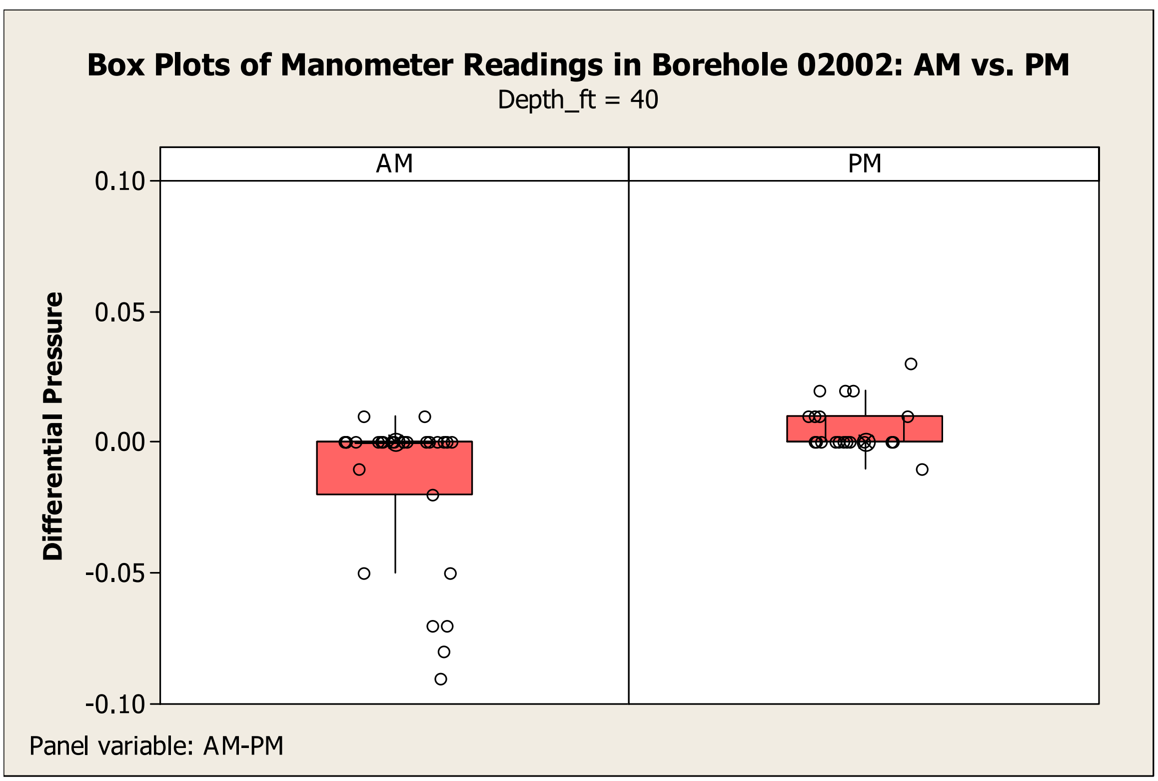

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 157
Differential Pressure
0.2
0.0
-0.2
-0.4
-0.6
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

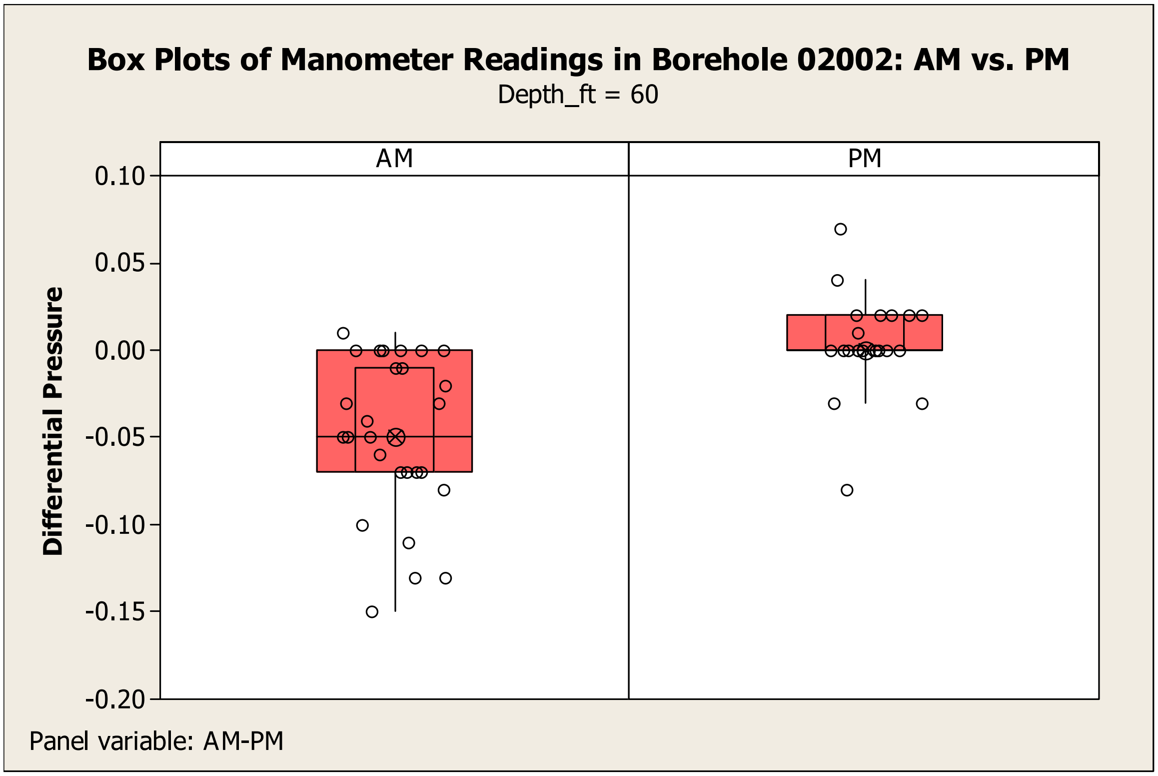

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 180
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

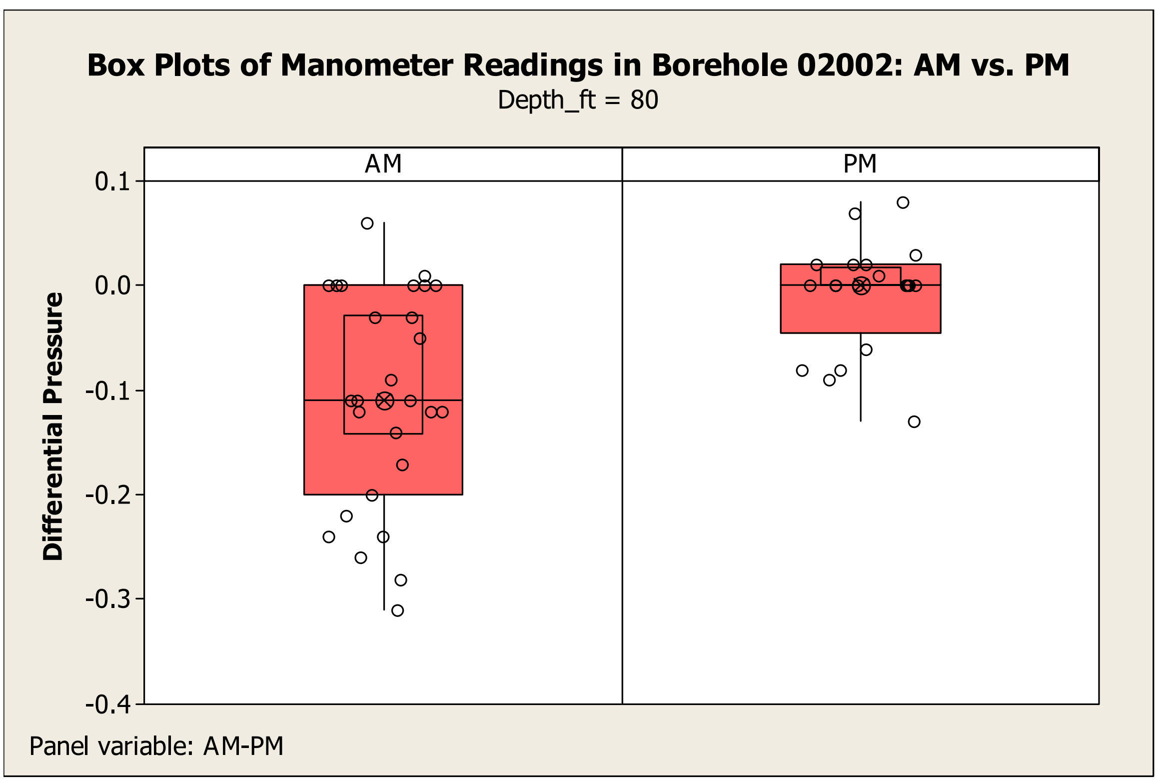

Scatter Plot of Differential Pressures in Borehole 54-02002
Depth_ft = 200
Differential Pressure
0.50
0.25
0.00
-0.25
-0.50
-0.75
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

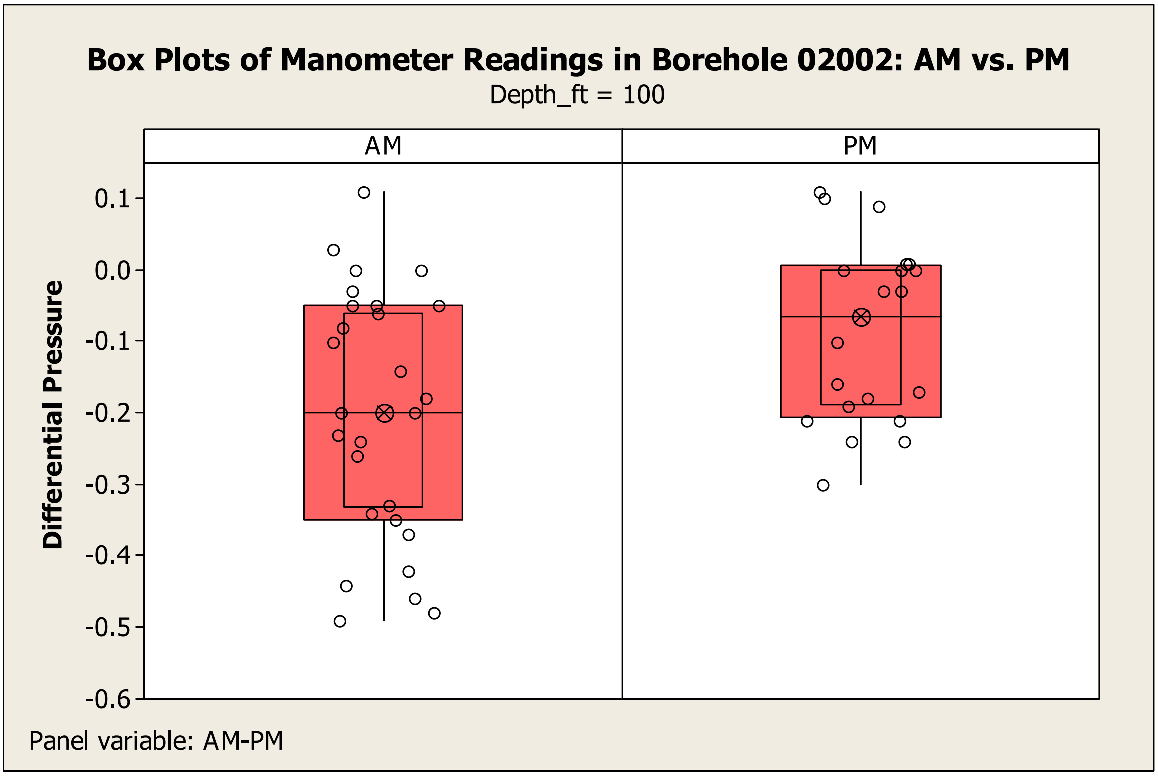
Boxplots of Manometer Readings in Borehole 54-02002: am versus pm

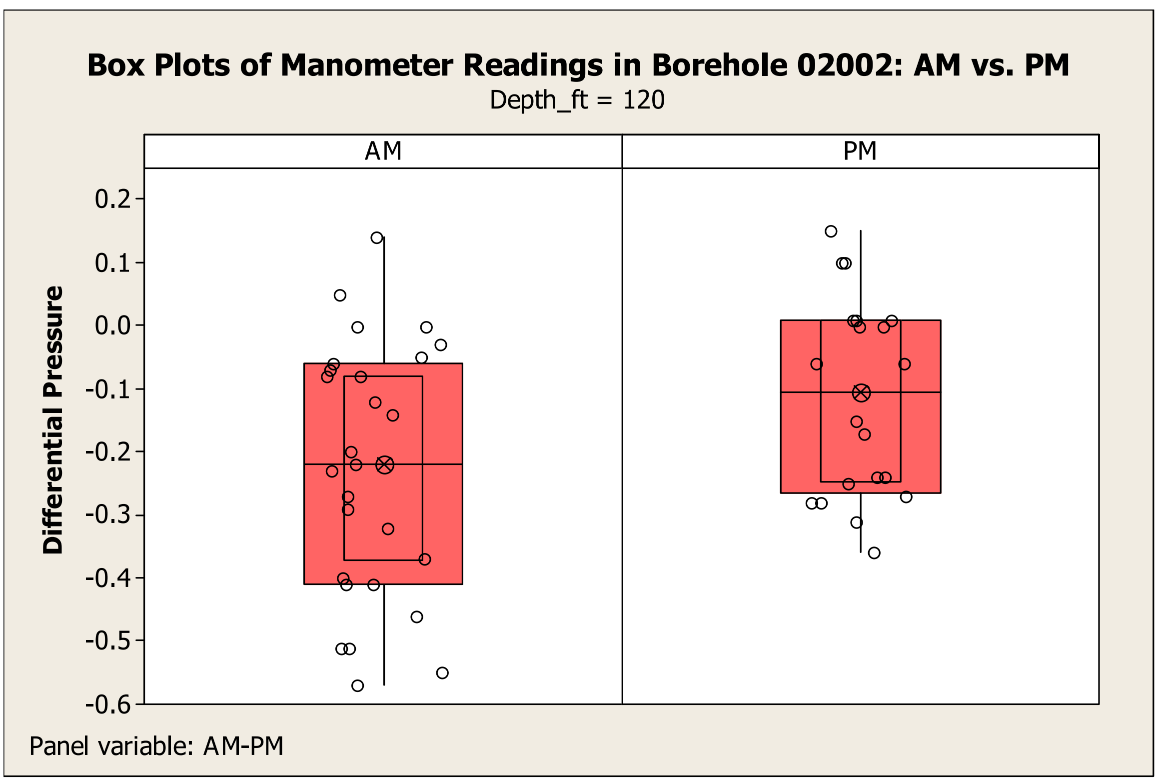


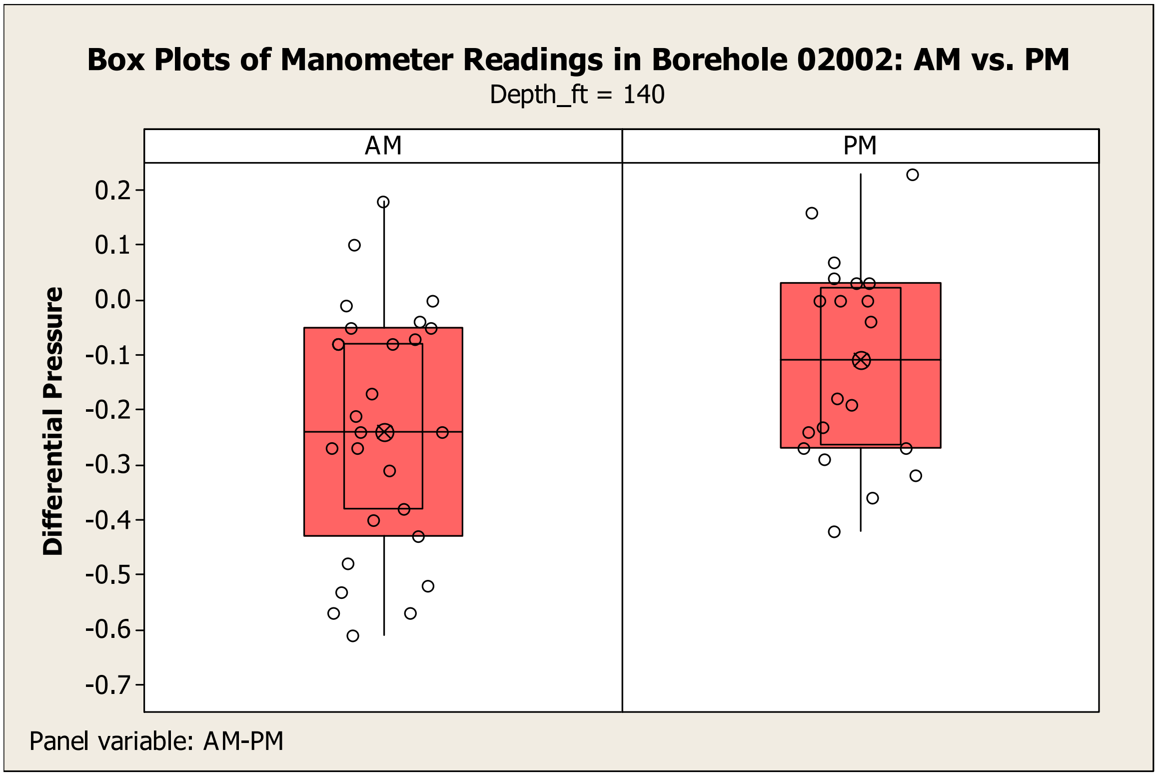


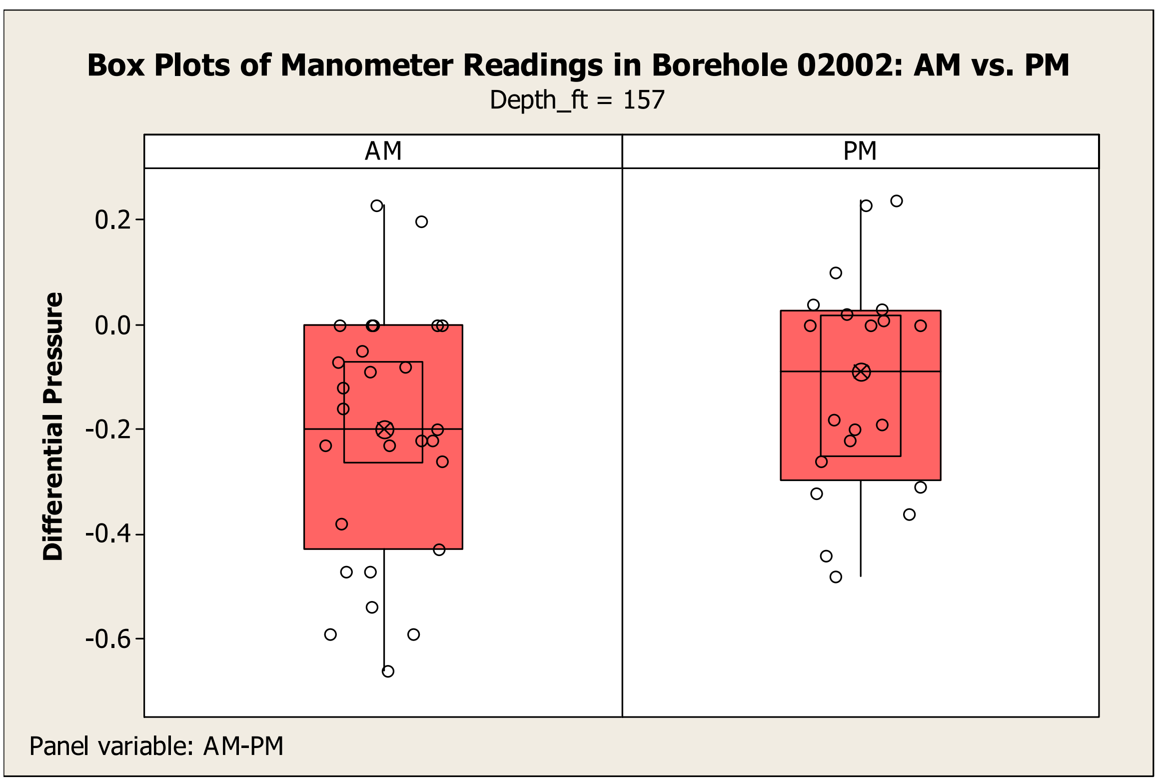

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 60
AM
PM
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
-0.20
Panel variable: AM-PM

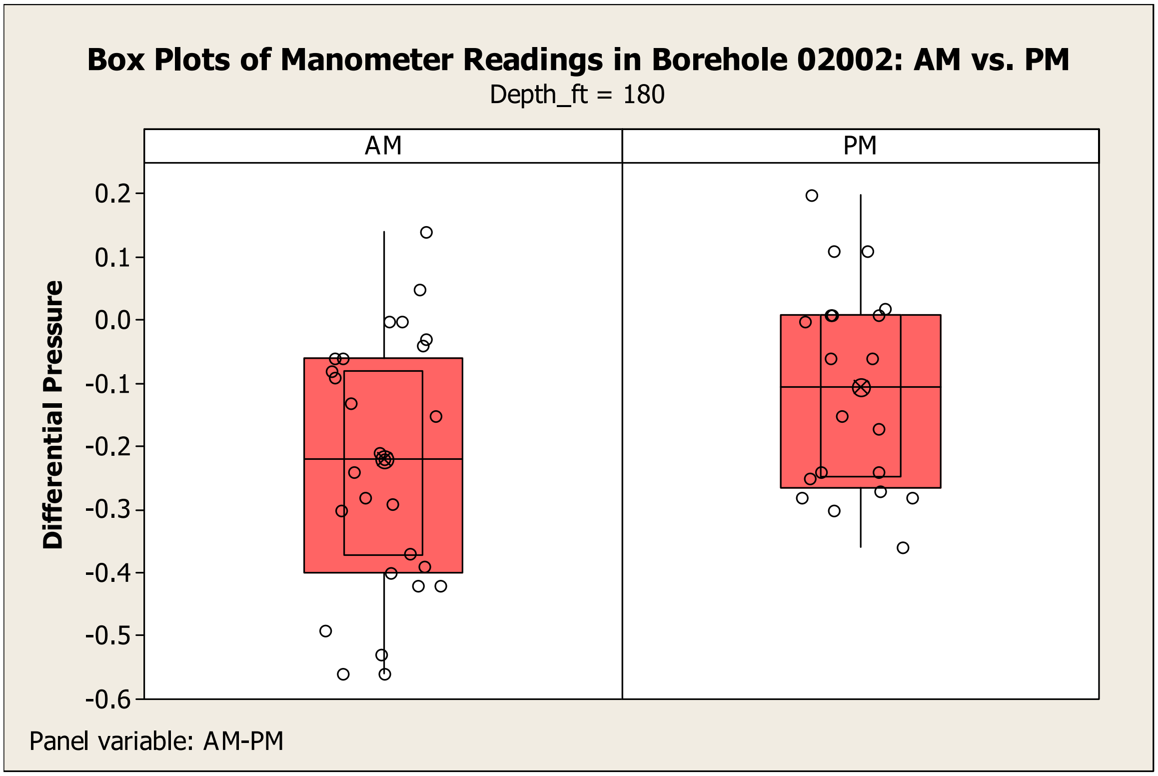

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 80
AM
PM
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
Panel variable: AM-PM

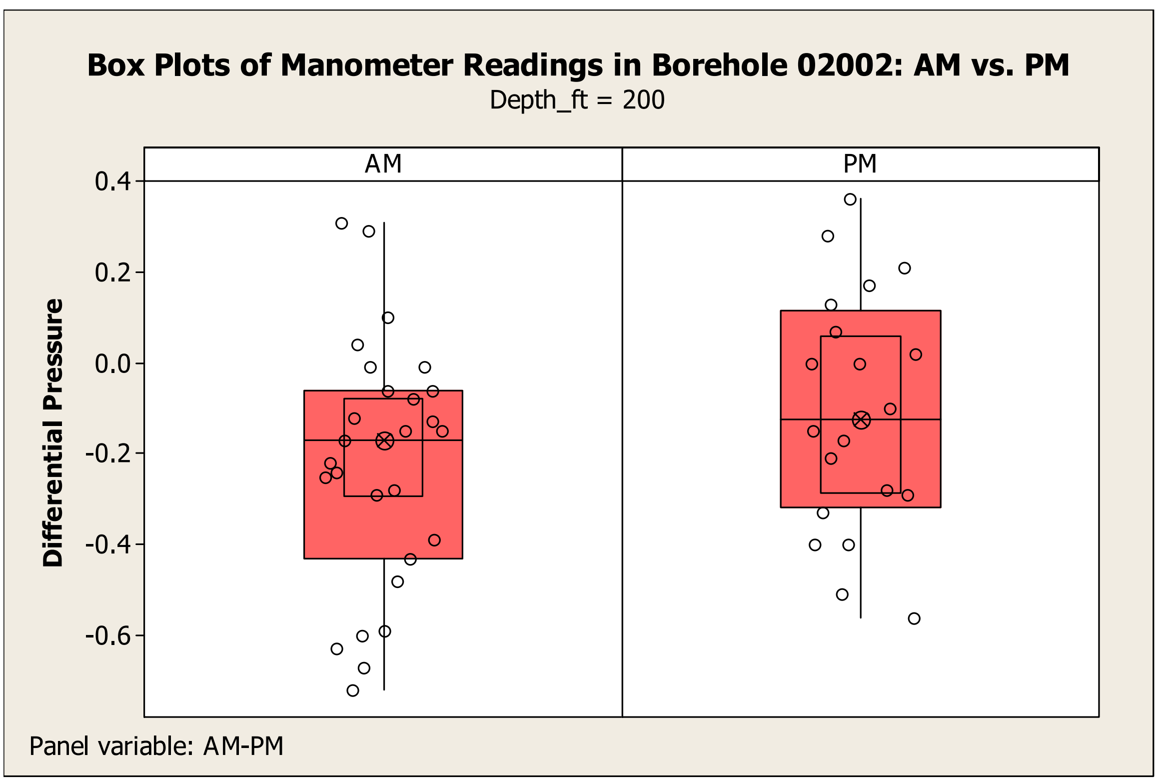

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 100
AM
PM
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Panel variable: AM-PM


Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 120
AM
PM
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Panel variable: AM-PM

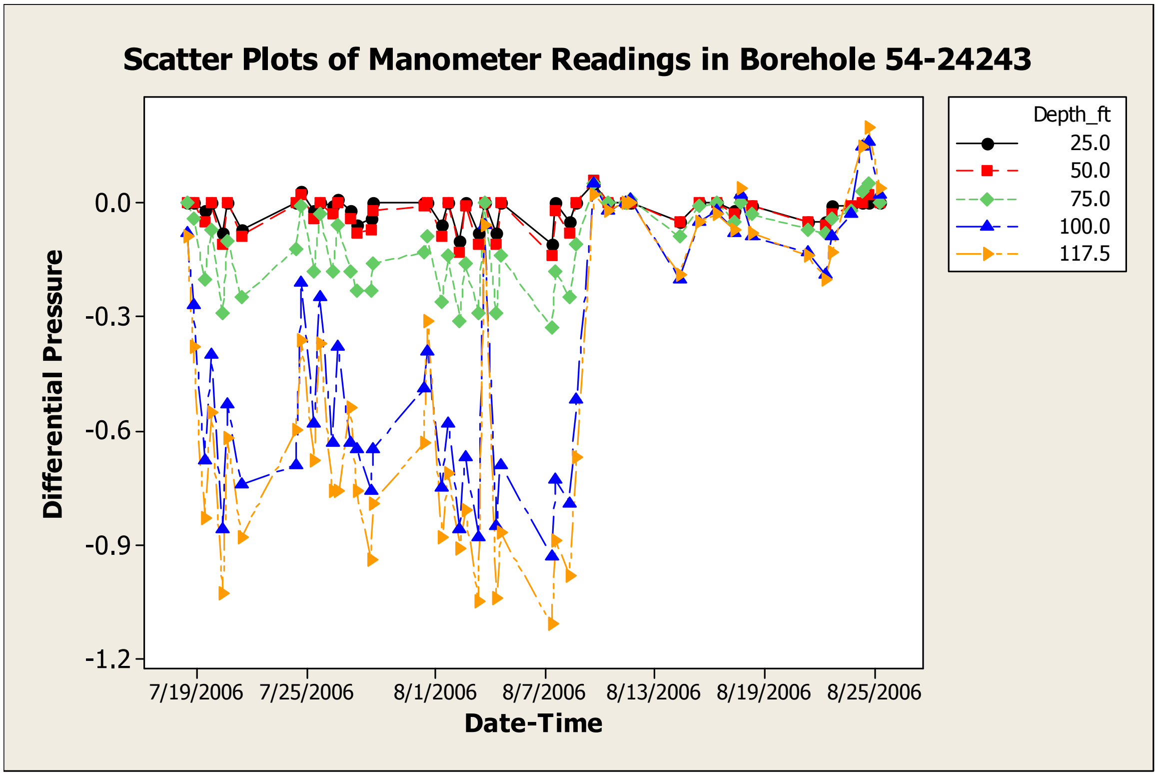

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 140
AM
PM
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
Panel variable: AM-PM

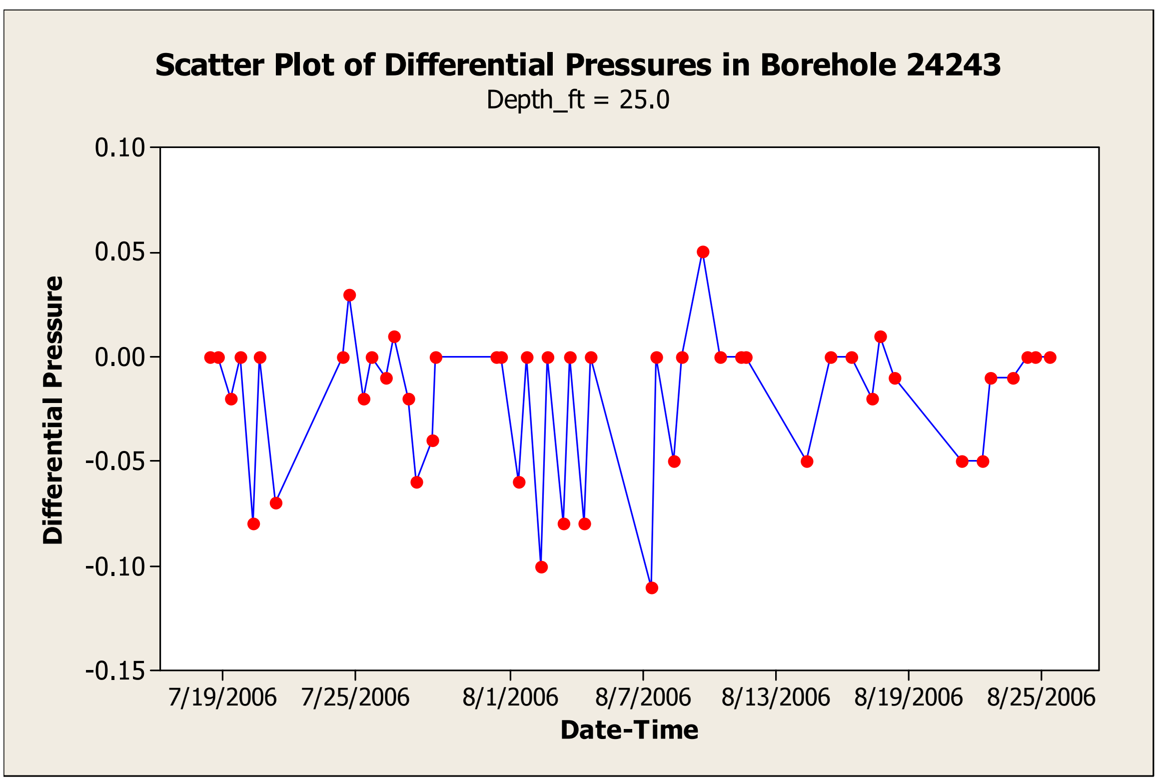

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 157
AM
PM
Differential Pressure
0.2
0.0
-0.2
-0.4
-0.6
Panel variable: AM-PM

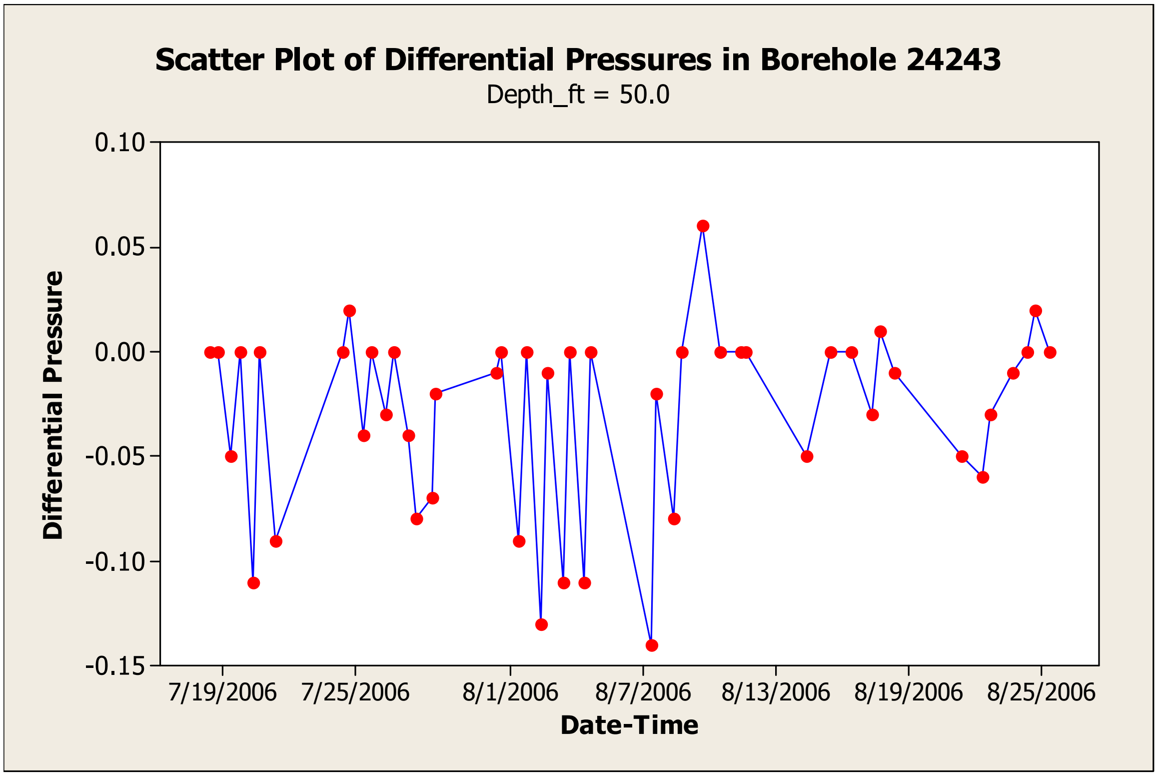

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 180
AM
PM
Differential Pressure
0.2
0.1
0.0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
Panel variable: AM-PM

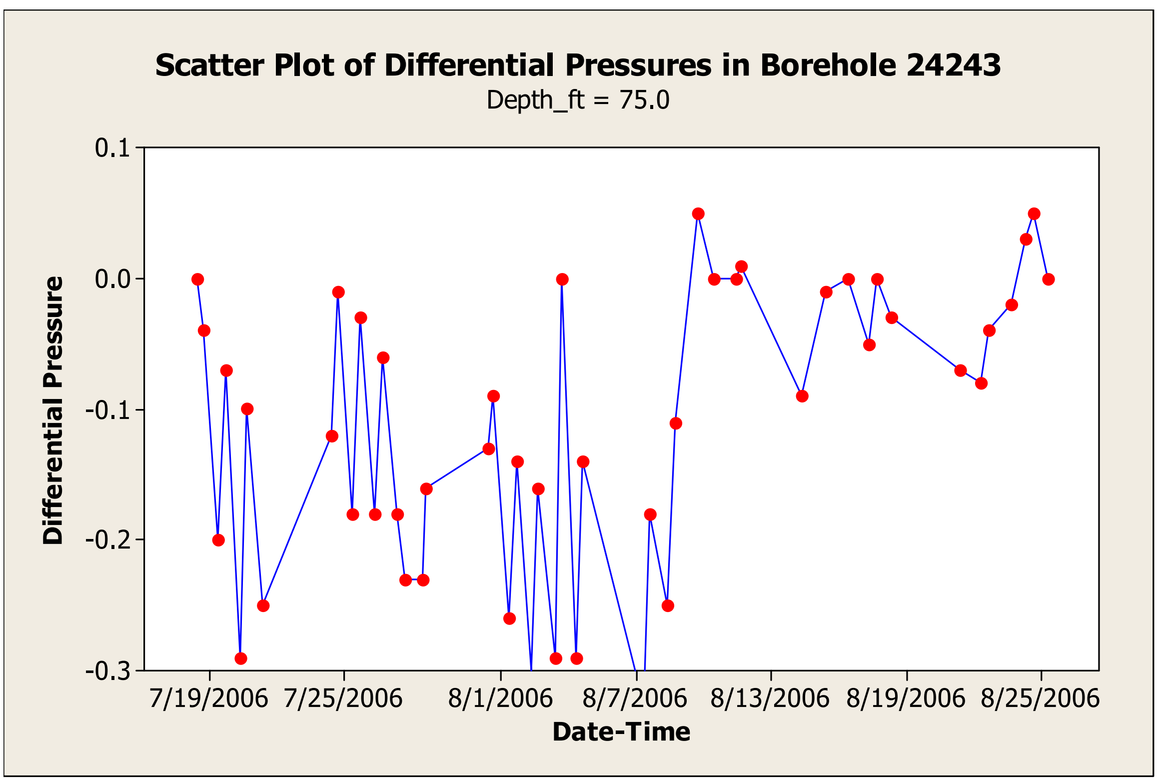

Box Plots of Manometer Readings in Borehole 02002: AM vs. PM
Depth_ft = 200
AM
PM
Differential Pressure
0.4
0.2
0.0
-0.2
-0.4
-0.6
Panel variable: AM-PM

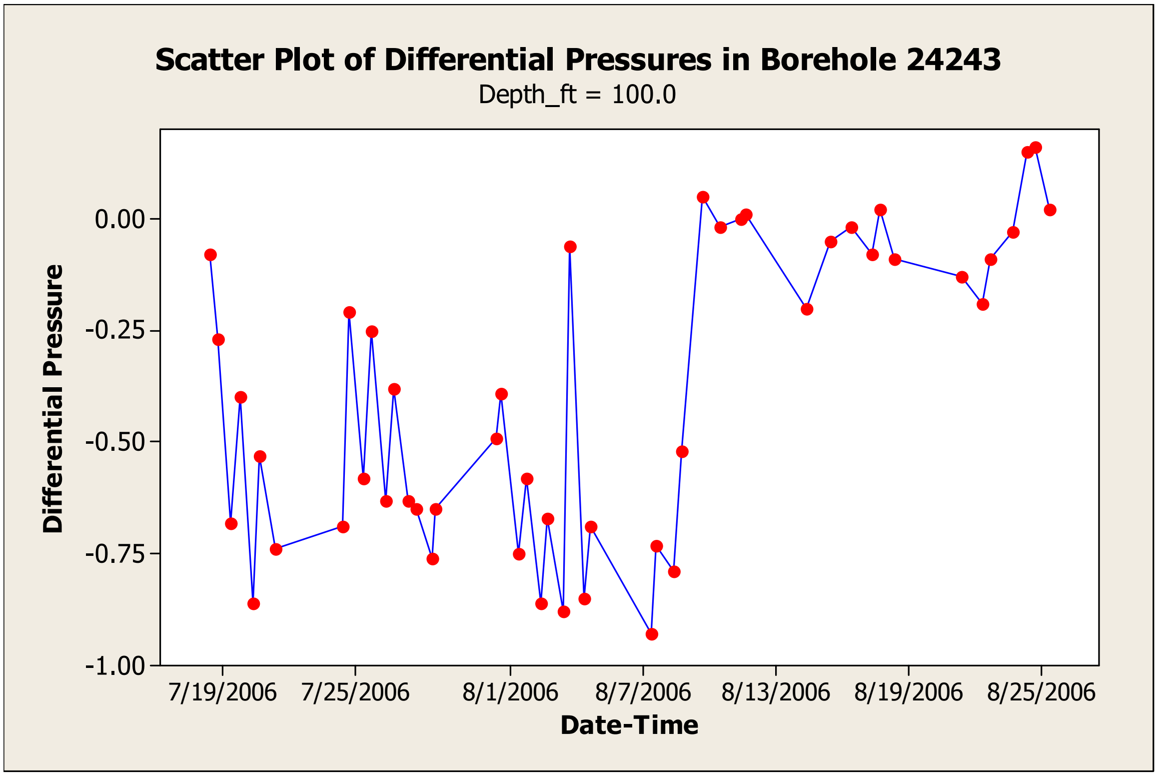
Scatterplots of Manometer Readings in Borehole 54-24243

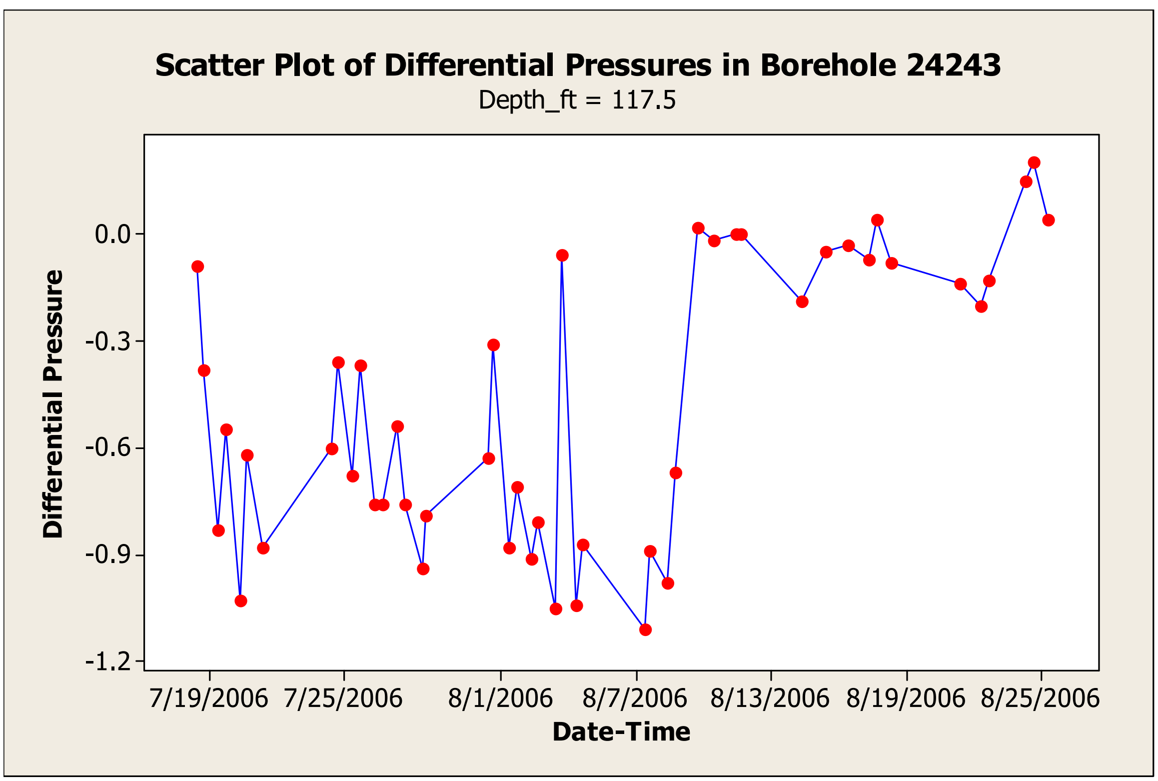




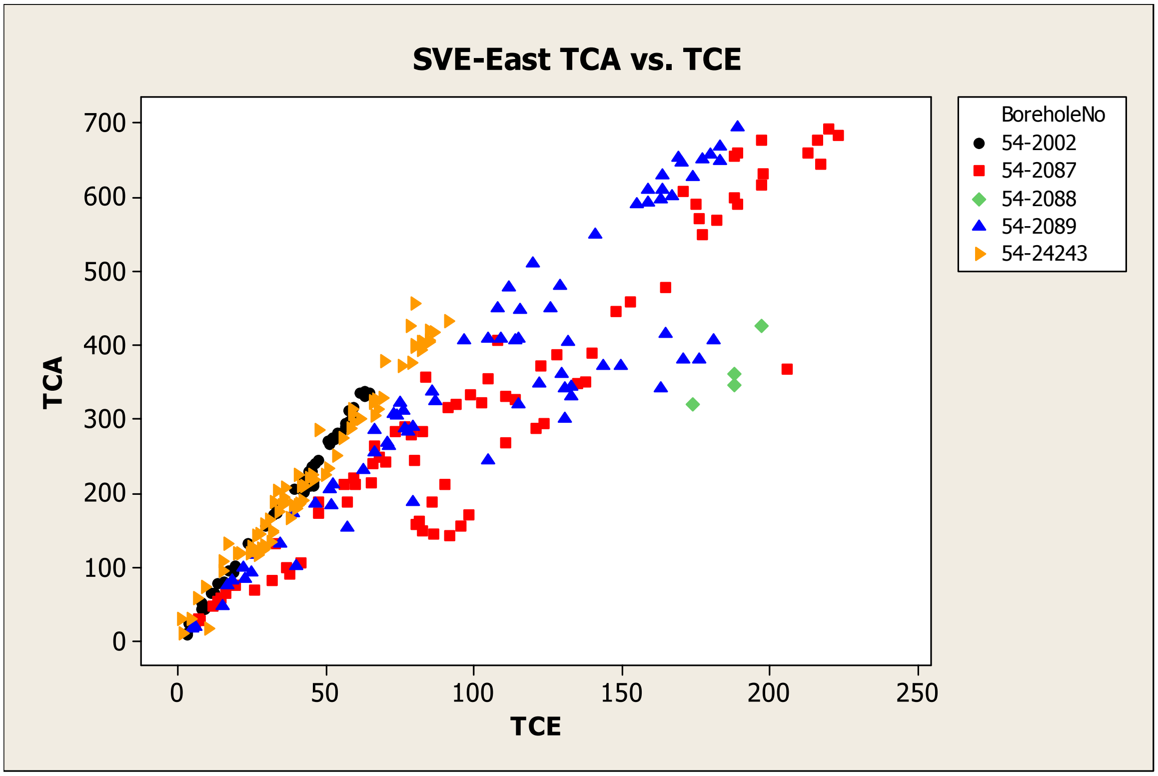

Scatter Plot of Differential Pressures in Borehole 24243
Depth_ft = 50.0
Differential Pressure
0.10
0.05
0.00
-0.05
-0.10
-0.15
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

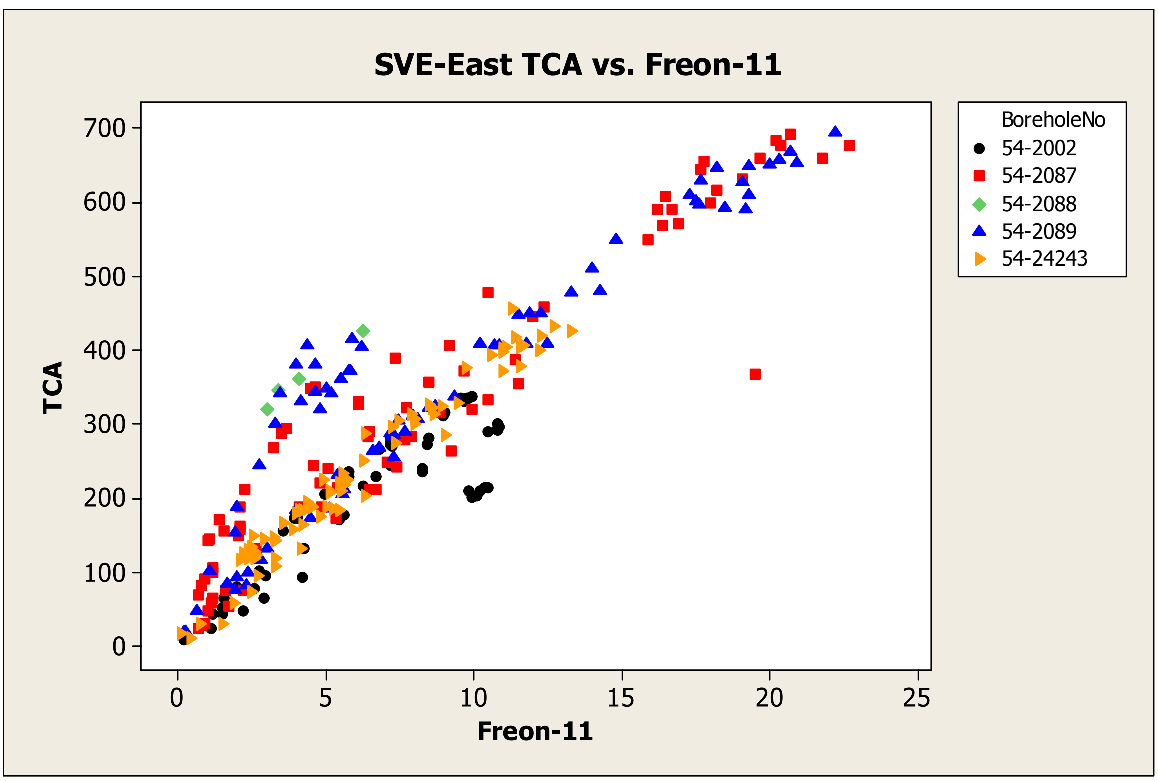

Scatter Plot of Differential Pressures in Borehole 24243
Depth_ft = 75.0
Differential Pressure
0.1
0.0
-0.1
-0.2
-0.3
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

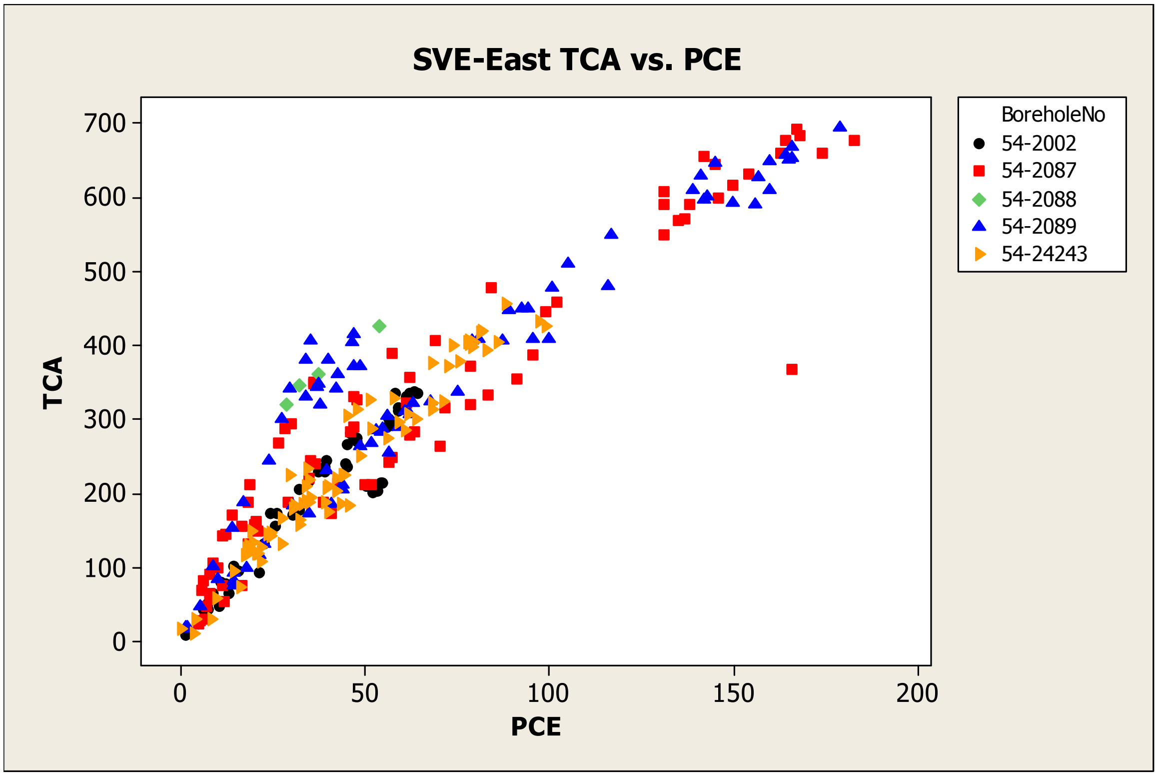

Scatter Plot of Differential Pressures in Borehole 24243
Depth_ft = 100.0
Differential Pressure
0.00
-0.25
-0.50
-0.75
-1.00
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

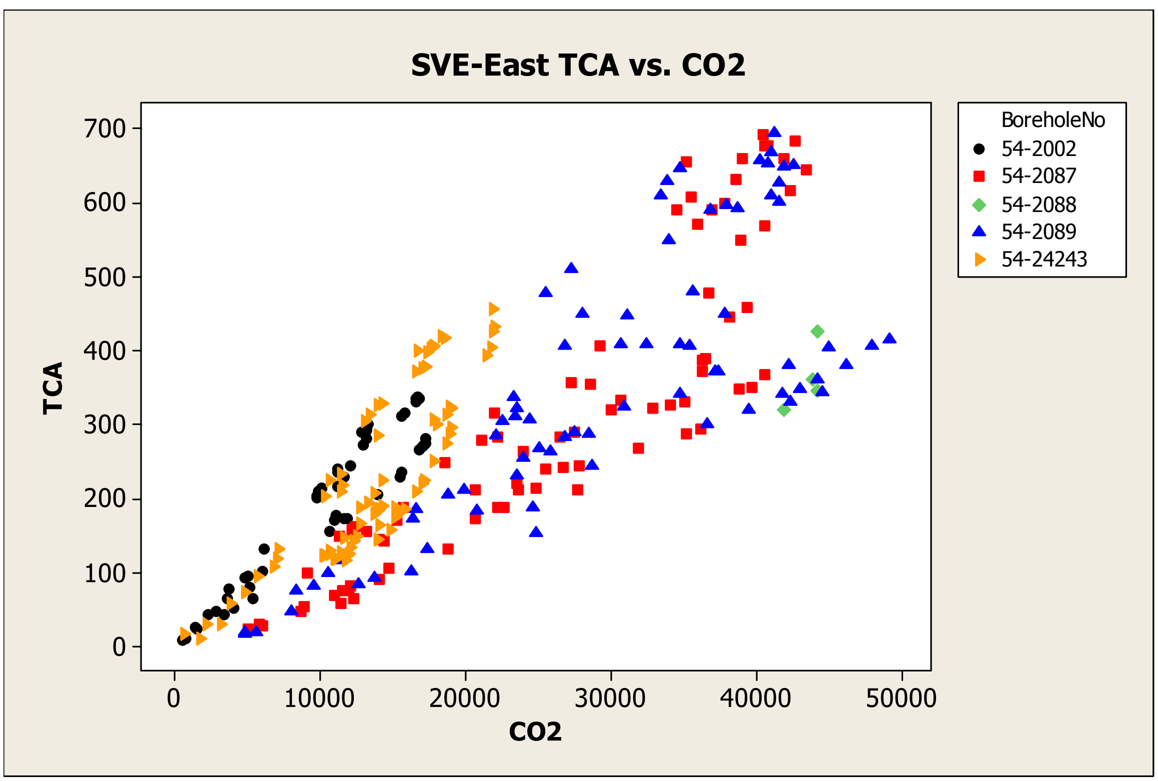

Scatter Plot of Differential Pressures in Borehole 24243
Depth_ft = 117.5
Differential Pressure
0.0
-0.3
-0.6
-0.9
-1.2
7/19/2006
7/25/2006
8/1/2006
8/7/2006
8/13/2006
8/19/2006
8/25/2006
Date-Time

SVE-East Plots Showing Correlations between Chemicals

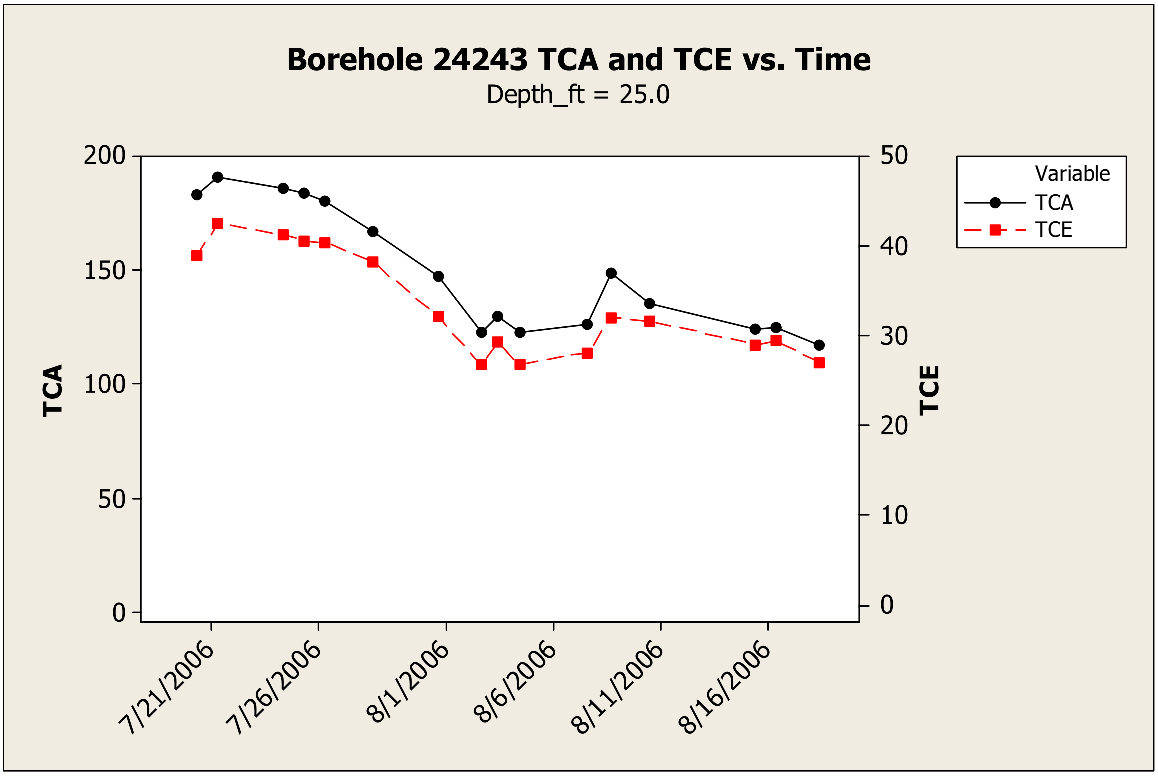


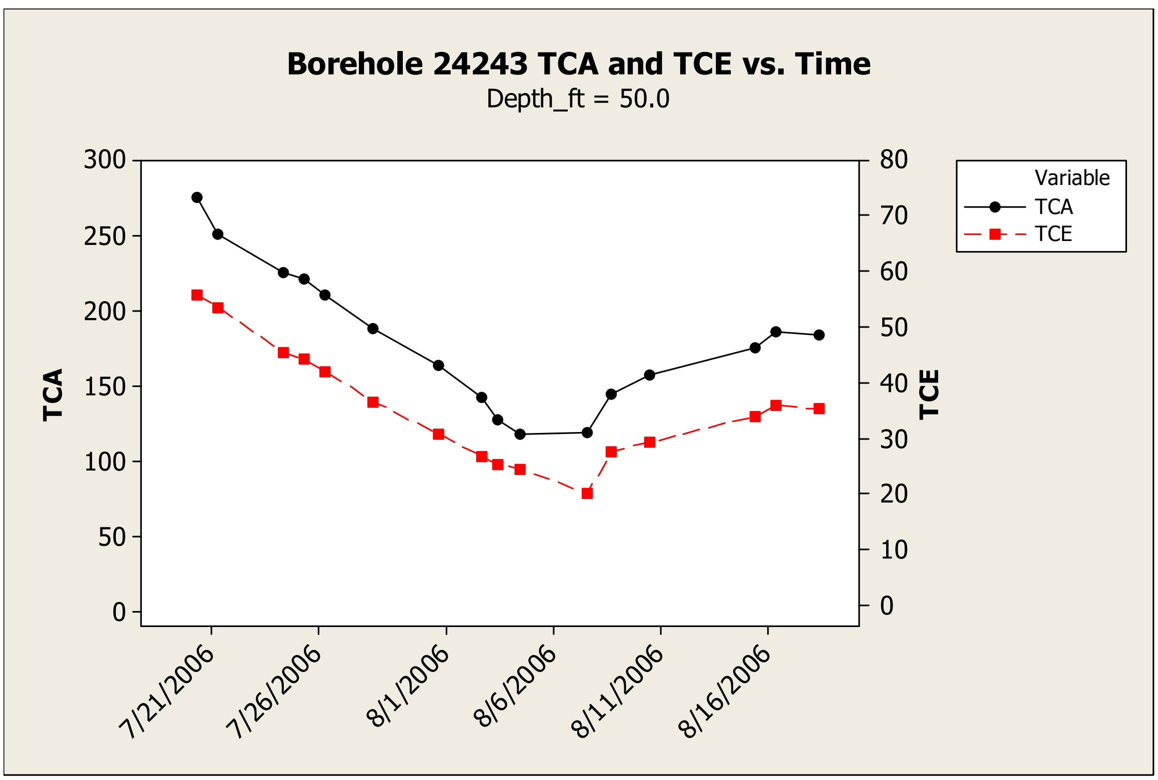


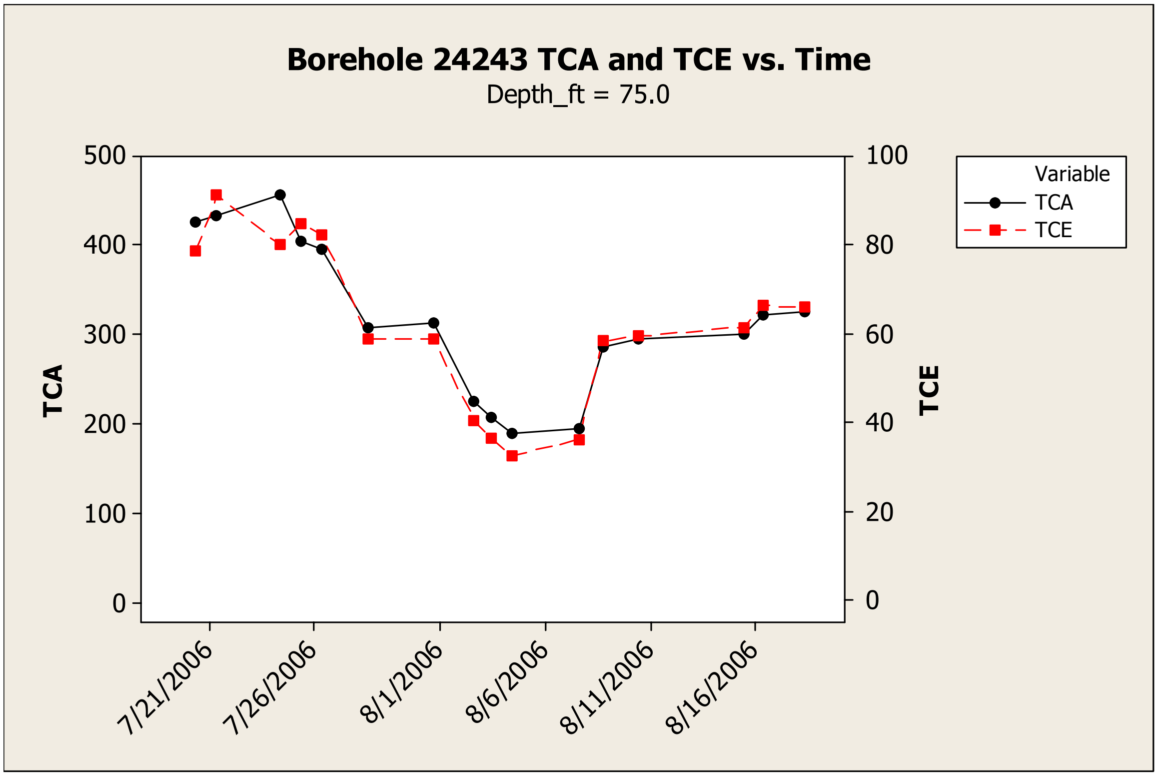

SVE-East TCA vs. PCE
TCA
PCE
0
100
200
300
400
500
600
700
0
50
100
150
200
BoreholeNo
54-2002
54-2087
54-2088
54-2089
54-24243

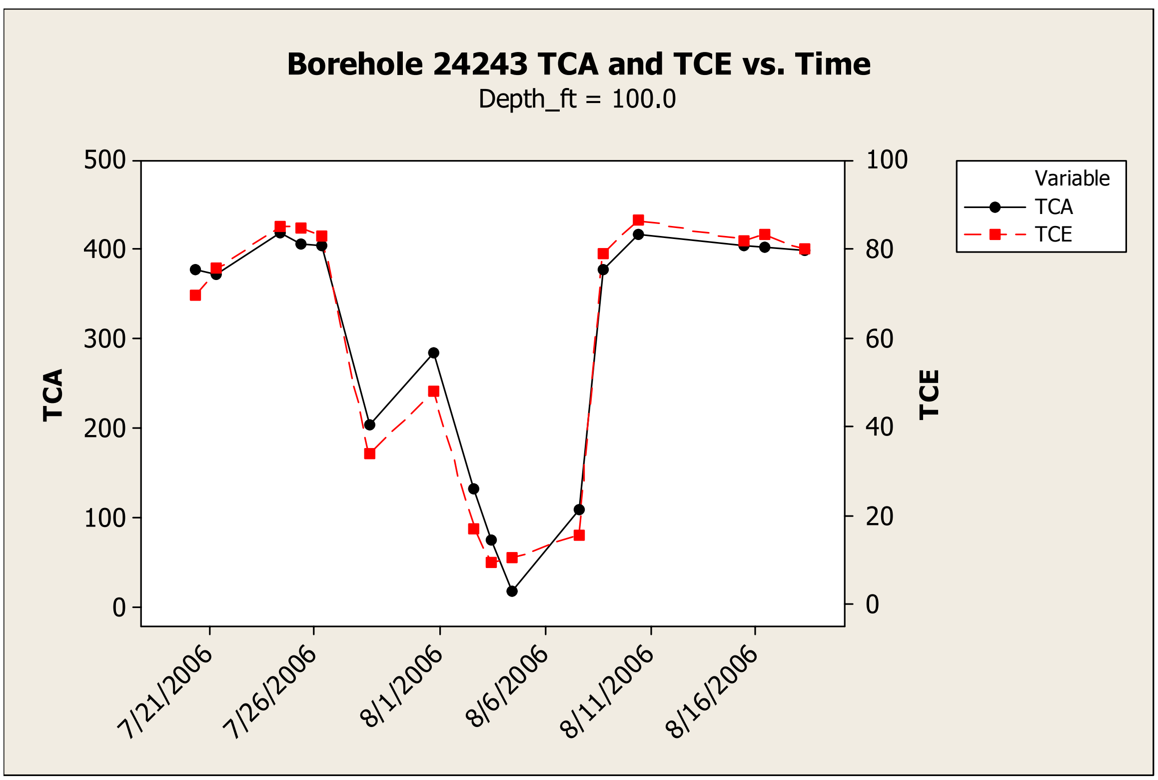

SVE-East TCA vs. CO2
TCA
CO2
0
100
200
300
400
500
600
700
0
10000
20000
30000
40000
50000
BoreholeNo
54-2002
54-2087
54-2088
54-2089
54-24243

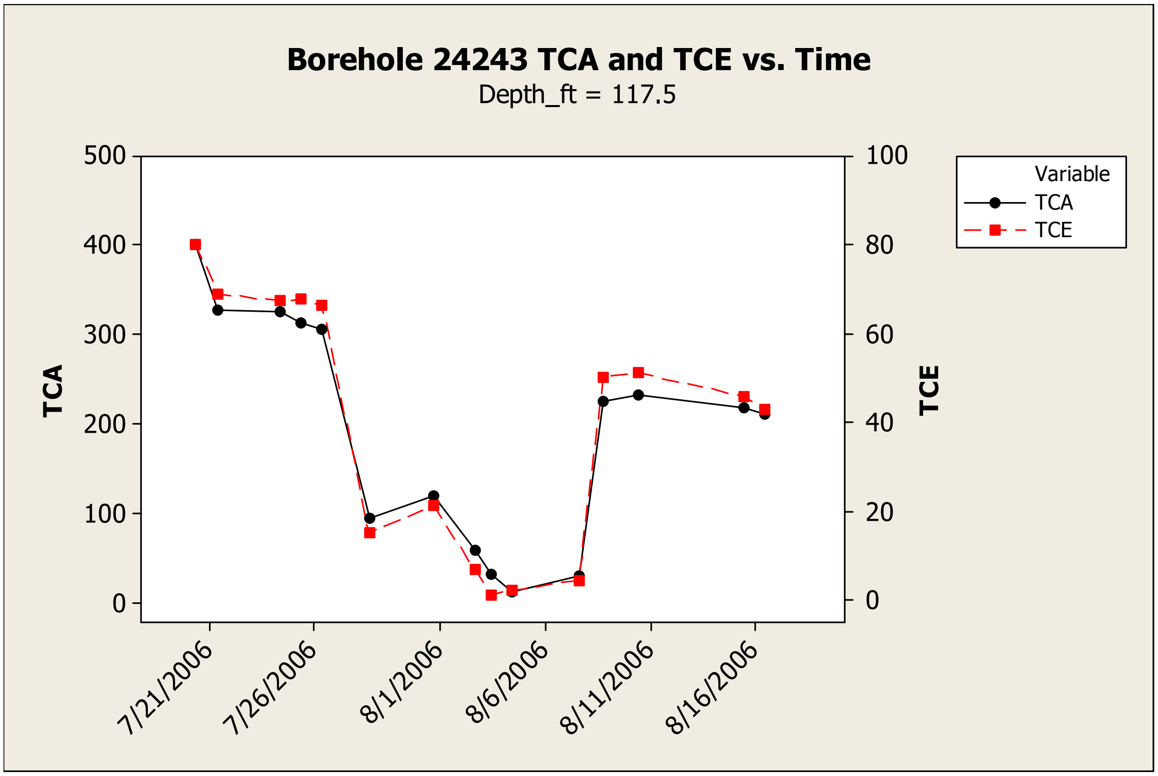
TCA and TCE versus Time in Borehole 54-24243






Borehole 24243 TCA and TCE vs. Time
Depth_ft = 75.0
TCA
TCE
Variable
TCA
TCE
7/21/2006
7/26/2006
8/1/2006
8/6/2006
8/11/2006
8/16/2006


Borehole 24243 TCA and TCE vs. Time
Depth_ft = 100.0
TCA
TCE
Variable
TCA
TCE
7/21/2006
7/26/2006
8/1/2006
8/6/2006
8/11/2006
8/16/2006


Borehole 24243 TCA and TCE vs. Time
Depth_ft = 117.5
TCA
TCE
500
400
300
200
100
0
100
80
60
40
20
0
Variable
TCA
TCE
7/21/2006
7/26/2006
8/1/2006
8/6/2006
8/11/2006
8/16/2006

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