Spring 5-4-2021

Geochemical Characterization of the Utica Shale Play using XRF-Based Chemostratigraphy in Ohio

Barbara Kemeh
barbarakemeh@yahoo.co.uk

Julie M. Bloxson
Stephen F Austin State University, bloxsonjm@sfasu.edu

GEOCHEMICAL CHARACTERIZATION OF THE UTICA SHALE PLAY USING XRF-BASED CHEMOSTRATIGRAPHY IN OHIO

By

BARBARA M. KEMEH, Bachelor of Science

Presented to the Faculty of the Graduate School of

Stephen F. Austin State University

In Partial Fulfillment

Of the Requirements

For the Degree of

Master of Science

STEPHEN F. AUSTIN STATE UNIVERSITY

May, 2021

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BARBARA M. KEMEH, Bachelor of Science

APPROVED:

Dr. Julie Bloxson, Thesis Director

Dr. R. LaRell Nielson, Committee Member

Dr. Kevin Stafford, Committee Member

Dr. Robert Friedfeld, Committee Member

Pauline M. Sampson, Ph.D
Dean of Research and Graduate Studies

ABSTRACT

The Utica shale is an extensive gas shale play within the Appalachian Basin, expanding from Quebec through New York, into Pennsylvania, West Virginia and Ohio. Currently a target for gas exploration, it is also the source rock for much of the Paleozoic reservoirs throughout the basin. However, the Utica-Point Pleasant lithology varies significantly across the Appalachian Basin which can make it challenging to characterize.

The Utica shale Play consists of the Trenton/Lexington Limestones, Point Pleasant Formation and Utica shale. The Point Pleasant Formation and Utica shale are often grouped together, especially in Ohio because they are difficult to visually distinguish from each other and their contact is not always marked by a change in log values. Here we show that chemostratigraphy reflects changes in depositional and facies characteristics of the Utica shale and Point Pleasant Formation.

For this study, two cores were analyzed using a handheld x-ray fluorescence (HH-XRF) spectrometer along with core descriptions, x-ray diffraction (XRD) and total organic carbon (TOC) data to interpret the depositional environment. Hierarchical clustering technique was used to identify five chemofacies which reflect the geochemical variability present in both cores. Six chemozones were identified and correlated using the chemofacies coupled with stratigraphic plots of selected major elements, trace metals and TOC. Detrital influx analysis revealed that the Utica-Point Pleasant interval in both cores were deposited in different water depths resulting in different amounts of terrigenous input. Paleoredox conditions revealed the Farley core was deposited in oxygenated bottom waters which account for the depletion of trace metals throughout the core. In the Tracker core, analysis showed that bottom-water conditions at the time of deposition varied between anoxic and euxinic. The Tracker core shares similar bottom-water conditions present in the Sebree Trough in Kentucky and is believed to have been deposited in an extension of the trough into northeast Ohio. The Farley core appears to have been deposited outside this trough and likely in the Utica-Point Pleasant basin. Overall the study supports the existence of different depocenters across the area with different conditions at the time of deposition.

ACKNOWLEDGMENTS

I would like to thank my family for their unwavering support and encouragement throughout graduate school. My advisor, Dr. Julie Bloxson, for her guidance with this research. My committee members, Dr. Nielson, Dr. Stafford and Dr. Friedfeld for their collaboration and review of my thesis.

Thank you to the Horace H. Collins Core Repository of the Ohio Department of Natural Resources (ODNR) - Division of Geological Survey in Delaware, Ohio for giving me access to the cores used in this research. This work also received financial support from the American Association of Petroleum Geologists (AAPG) Grants-in-Aid and the Department of Geology at Stephen F. Austin State University.

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INTRODUCTION

Mudstones constitute about two-thirds of the sedimentary rock record (Wedepohl 1971; Stow 1981; Potter et al. 2005) and serve as petroleum source rocks, unconventional reservoirs and seals. Shale gas plays have recently gained prominence in the production of hydrocarbons (Stevens and Kuuskaraa, 2009). The emergence of horizontal drilling, hydraulic fracturing, and completion technology has enabled the oil-and-gas industry to produce hydrocarbons from these shale plays, making them economical and significant in hydrocarbon exploration.

The complex mineralogy and diverse nature of these mudrocks make them challenging to characterize. Although mudrocks appear to be homogenous on a regional scale, their geochemical properties are variable on a smaller scale, varying both laterally and vertically across centimeters. The major influences on variability in mudrocks include tectonic setting, water depth, oxygenation, climate, eustasy, and detrital influx which control composition, fabric, and texture. Thus, different lithofacies are produced from changing transport and depositional processes, while mineralogical and total organic carbon (TOC) variations can be attributed to proximity to sediment source. In order to examine these variations, additional techniques are required to supplement traditional analytical methods (Wright et al. 2010b). Geochemical techniques aid in identifying variations in elemental, mineralogical, organic content, which can be used in characterizing reservoir rocks in the Utica shale Play.

The Upper Ordovician Utica shale play is one of the major natural gas producers in the eastern United States. It consists of the Utica shale, Point Pleasant Formation and the Trenton/Lexington Limestones. The Utica-Point Pleasant is a mixed siliciclastic-carbonate system, with its lithology varying significantly across the Appalachian Basin making it challenging to characterize. This lithological heterogeneity is controlled by depositional and diagenetic processes (Roen and Walker, 1996). Using chemostratigraphic data increased the understanding of the depositional and facies characteristics of the Utica shale and Point Pleasant Formation in Ohio.

While there are several cores located across the state that contain the Utica/Point Pleasant, there are limited core data within the "sweet spots" for exploration, which results in little information on the Utica shale and Point Pleasant Formation beyond well log information and extrapolation from non-productive areas to deeper within the Basin. Chemostratigraphic correlations can help better define the depositional model of the Utica shale and Point Pleasant Formation, such as water depth, anoxia events, and controls on depositions (i.e., tectonic, climatic, etc.). This study developed an approach to chemostratigrapic characterization and correlation using XRF elemental geochemistry to provide insights into the depositional environment and identify productive zones of the Point Pleasant Formation as well as the Utica shale. The variation in elemental geochemistry was used to infer the depositional environment, sediment source and facies changes in addition to other datasets such as x-ray diffraction (XRD) and total organic carbon (TOC).

Chemostratigraphy relies on identifying variations in element concentrations through an interval and using these changes to develop a stratigraphic characterization that is based on changes in geological features, such as paleoclimate (Pearce et al., 2005b, Ratcliffe et al., 2010) and provenance (Ratcliffe et al., 2007, Wright et al., 2010). Certain elements can be interpreted as proxies for local depositional and environmental conditions during sedimentation (Pearce & Jarvis 1992; Pearce et al. 1999; Tribovillard et al. 2006; Nance & Rowe 2015; Turner et al. 2015). Titanium, Zr, K and Al are detrital elemental proxies that indicate transgression and regression (Coleman and Jordan, 2018). Calcium, Mg and Sr are associated with carbonate accumulation (Banner, 1995). Aluminum and K are associated with feldspars and clays. The combined use of Mo, V and U is used in distinguishing suboxic environments from anoxic-euxinic ones. Nickel, Cu and Zn are enriched in organic molecules that can be used as a proxy to interpret organic matter abundance. Interpretations were based on raw elements, elemental ratios or cross-plots. However, the abundance of XRF data can be a challenge to interpret, hence the data was sorted into geochemically similar groups (chemofacies) using hierarchical cluster analysis (HCA). Plotting the stratigraphic distribution of chemofacies reveals patterns that may not be obvious by viewing elemental profiles separately (Nance & Rowe 2015; Turner et al.

2015). The XRF data collected on the cores were used to correlate chemostartigraphic zones between the cores based on interpreted chemofacies.

The focus of the study was to establish chemostratigraphic correlations and paleoenvironment proxies, such as water bottom oxygen levels, based on trace metal concentrations within the Utica shale and Point Pleasant Formation across Ohio which will help formally characterize the Utica shale within the state. The Point Pleasant Formation and Utica shale are often grouped together, especially in Ohio because they are difficult to distinguish from each other and their contact is not always marked by a change in log values. Stratigraphic variations in inorganic geochemistry will allow clear differentiation of the Utica shale from the underlying Point Pleasant formation. This will address the limitation that typical geophysical well logs have with distinguishing shale-to-shale intervals like the Utica shale and Point Pleasant Formation in the play. Elemental data collected can also provide important information on bottom water conditions at the time of deposition, which is an important factor for the industry when it comes to well placement.

Recent studies have shown the Trenton/Lexington Limestones, Point Pleasant Formation and Utica shale do not exhibit “layer cake” stratigraphy across the state but rather are influenced by various depositional features like the Sebree Trough (Bloxson, 2017). The Sebree Trough, a linear bathymetric depression for graptolitic shales, was thought to have stopped in the southwestern part of Ohio. However, emerging evidence, including geochemical data presented here, suggests that it extended towards northeastern

Ohio and reflects a different depositional environment from the Utica-Point Pleasant sub-basin. This study uses chemostratigraphy to analyze two cores to show the existence of different bottom-water conditions which confirm the extension of the trough and its influence on deposition in northeast Ohio.

GEOLOGICAL SETTING AND REGIONAL GEOLOGY

The Appalachian Basin is bounded to the west by the Cincinnati, Findlay, and Algonquin arches, and the east by metasedimentary, metavolcanic, and intrusive Precambrian and Paleozoic rocks of the Adirondack dome, Blue Ridge and New England Uplands. The northwestern boundary in southeastern Ontario and southern Quebec and the southern boundary is transitional into the Black Warrior Basin (Ettensohn, 2008). The Utica shale play was deposited in the Appalachian Basin that is parallel to the present-day Appalachian Mountains during the Late Ordovician.

During the Middle Ordovician and throughout the Paleozoic Era, the continental margin was active, and most of the clastic detritus deposited in the foreland basin was derived from eastern orogenic source areas (de Witt, 1993). According to Nanace and Murphy (1994), the Early-Middle Ordovician transition (472 Ma) resulted in the development of the Appalachian Basin with the emergence of Paleozoic orogeny that continued for about 200 Ma with the growth of the interior Appalachian orogeny (Figure 1). The accommodation space for the basin was created through the gradual growth of this interior orogeny due to tectonic loading (Beaumont, 1981; Quinlan and Beaumont, 1984).

During the Middle and Late Ordovician, Laurentia was located between 20° – 25°S latitude (Scotese, 2003). A peripheral foreland basin and flexural loading of the Laurentian margin was the result of the closure of the Iapetus Ocean and collision of various island-arc terranes during the Middle and Late Ordovician Taconian Orogeny (Kay 1951; Jacobi 1981; Bradley 1989; Drake et al. 1989; Bradley and Kidd 1991; Mac Niocaill et al. 1997; Ettensohn and Brett 2002; Wise and Ganis 2009; Horton et al. 2010). The location of Laurentia along with the continued closing of the Iapetus allowed for the majority of Ohio to be submerged by tropical inter-continental seas. These warm waters resulted in the global deposition of shallow-water carbonate beds.

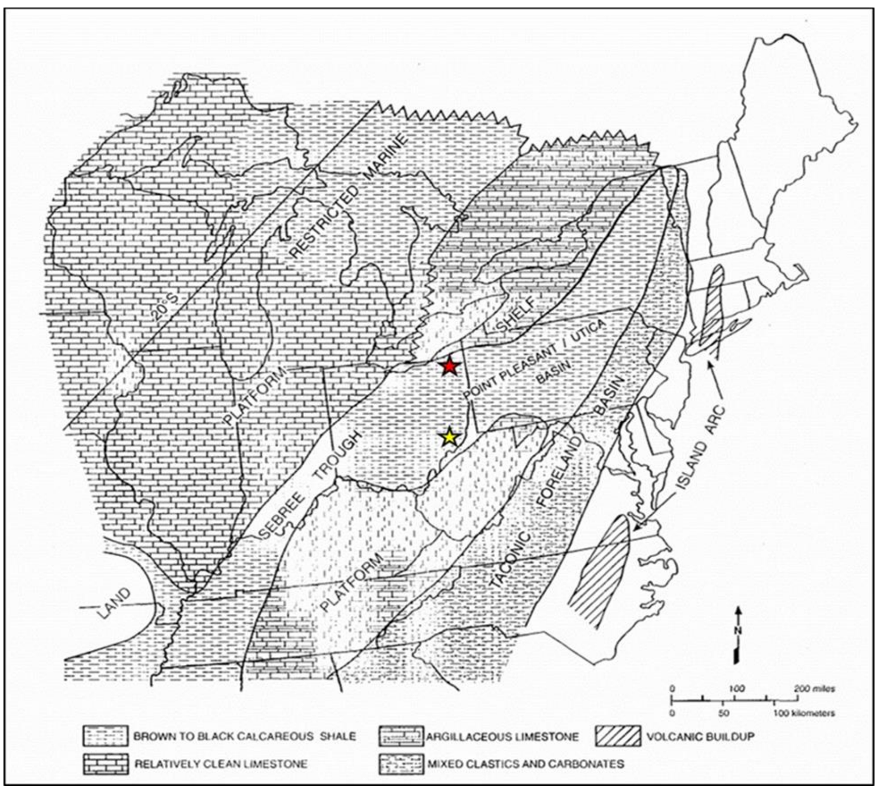


Figure 1. Depositional reconstruction and tectonic elements present during Utica-Point Pleasant deposition. Red and yellow stars represent the Tracker and Farley core respectively. Modified from Keith, (1988), Wickstrom et al., (1992b).

The period of deposition of the Utica shale is the second of three tectonically related depositional phases associated with the Taconian orogeny during the Ordovician (Ettensohn, 2008). The earliest phase, the Blountian tectophase (Middle to Late Ordovician), begins with basal transgressive carbonate overlain by dark, graptolitic shales. The Taconic tectophase (Late Ordovician) represents subduction and collision with island-arc terranes and the final phase (latest Ordovician and Early Silurian time) with increased tectonic influence. This late Ordovician (Mid-Caradoc-Ashgill; Late Mohawkian Cincinnatian) tectophase resulted in a widening of the foreland basin, which is indicated by the deposition of the Reedville, Martinsburg, Antes and Utica dark shales (Ettensohn (1994).

Trenton time was marked by the appearance of the Trenton platform in the north and the Lexington platform to the south. These two platforms were separated by a shallow, interplatform subbasin that covered much of what is now Ohio. During early Trenton time, low-relief carbonate buildups developed on the Trenton and Lexington platforms that underlie and surrounded the interplatform Utica shale/Point Pleasant sub-basin and Sebree Trough. According to Patchen et al. (2015), deposition of the Utica shale and Point Pleasant Formation began at the same time with the Trenton carbonate buildup in response to compression from the Taconic orogeny, which altered the basin shape and water bathymetry.

Also during deposition of the Trenton/Lexington carbonate platforms, during the late Turinian to early Chatfieldian time (Mohawkian Series), a linear bathymetric depression termed the Sebree Trough separated the two carbonate platforms throughout Tennessee, Kentucky and into southwestern Ohio. This trough is thought to have formed due to cold, phosphate rich, anoxic waters upwelling along the failed Reelfoot Rift system, and trapped siliciclastic sediments that were shed from the Taconian orogeny (Kolata et al., 2001). The Sebree Trough contains dark graptolitic shales, including the Utica shale, and is in part coeval with the Trenton Limestone to the northwest of the trough and the Lexington Limestones to the southeast (Figure 1). It is unknown if this feature was a bathymetric low or simply an area of anoxia, causing a lack of deposition of carbonates and preferentially allowed for siliciclastic deposition. The trough has been identified by a lack of carbonate platform and increased thickness of these dark, fine-grained sediments (Kolata et al., 2001).

The deposition of Trenton platform carbonates and contemporaneous interplatform shales represent major sedimentological and structural changes to the region due to the ensuing Taconic Orogeny. The increase in orogenic activity caused the foreland basin to deepen, resulting in the organic-rich Utica shale transgressing the area, drowning the carbonate environments. The Utica-Point Pleasant interval was deposited during a major transgression across the eastern United States. The shale composition indicates high organic matter influx, restricted circulation, and low energy conditions. The Utica shale and Point Pleasant Formation represent a deeper basin, relative to the Trenton Platform milieu, with an inter-platform, restricted circulation, and anoxic depositional environment. Deposition of these units ended with complete flooding of the region by deeper water and open marine conditions represented by the Cincinnati Group, which sits above the Utica formation (Patchen et al., 2015). As a result of this, the Utica shale is laterally equivalent and overlies the Point Pleasant Formation in deeper areas of the present-day Appalachian Basin.

REGIONAL STRATIGRAPHY

The tectonic features controlling depositional and burial history of the Utica-Point Pleasant interval as well as other sedimentary formations in the region are related to the basement structure of the Appalachian Basin, coupled with major interpreted faults and the projected position of the Rome trough. The basin dips from a zero-edge in the northeast to the southwest, reaching a depth of more than 5 km (0.6 mi) at the thrust-and-fold belt of the Appalachian. Ettensohn (2008) ascribes the factors controlling deposition to the nature of the Precambrian basement, paleogeographic/paleoclimatic framework, eustatic fluctuations, and the flexural history of adjacent orogens.

The Ordovician Utica shale and Point Pleasant Formation are the formations of interest in this study. The Point Pleasant is in a gradational relationship with the overlying Utica shale. The Point Pleasant Formation and Utica shale are often grouped together, especially in Ohio because they are difficult to distinguish from each other and their contact is not always marked by a change in log values. However, the contact between the two formations can sometimes be seen by a sharp contact in core samples and the tendency of the Utica shale to be darker in color and more enriched in shale compared to the Point Pleasant Formation. The Point Pleasant Formation forms a transition from the limestones of the Trenton and Lexington into the Utica shale (Figure 2). The Utica shale also shows an increase in gamma ray values on well logs due to the carbonate content in the Point Pleasant Formation.

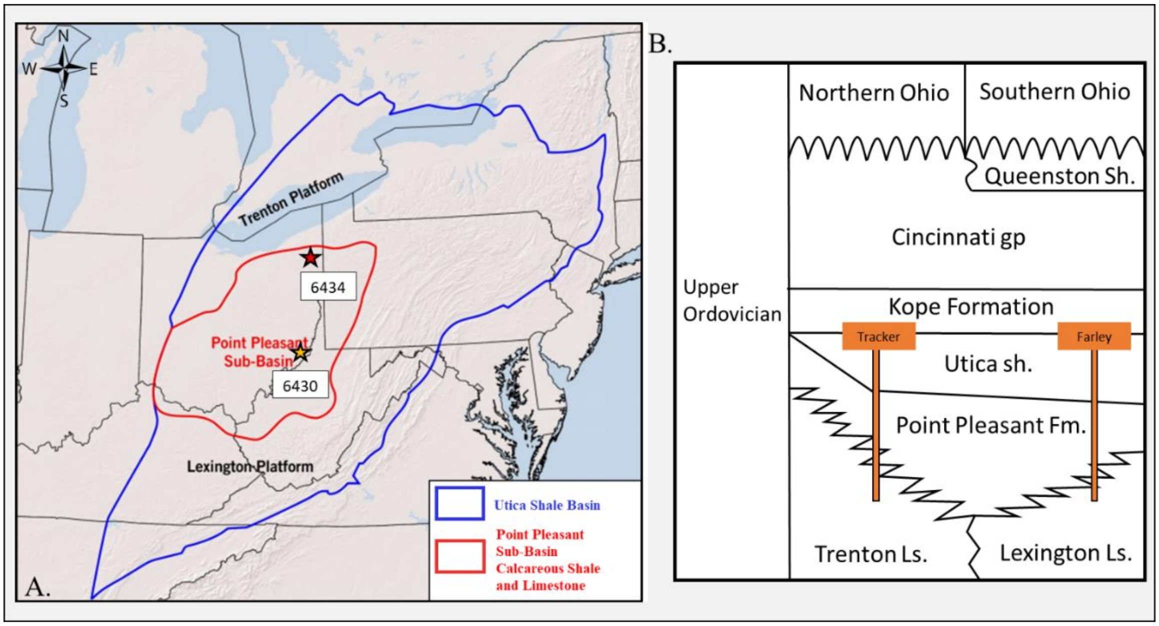


Figure 2. (A) Extent of Utica shale and Point Pleasant Formation throughout the Appalachian basin and location of cores used in the study. Red and yellow stars represent the Tracker and Farley core respectively. Modified from Jefferies, 2013. (B) Generalized stratigraphic column for the Upper Ordovician of Ohio. Orange represents the relative core interval/location. Modified from Patchen et al., 2006.

Trenton/Lexington Limestone:

The Trenton Limestone consists of whole or fragmented fossils set in a fine, dark-gray to light-brown matrix (Wickstrom et al., 1992). It lies above the Black River Group in Ohio, while the Trenton platform extends from southeast Michigan and Indiana to New York (Patchen et al., 2006). The Trenton/Lexington Limestone grades laterally and upward to predominantly dark-gray to brown-to-black, platy, finely laminated, locally calcareous organic shale and interbedded limestone and calcareous shale of the Point Pleasant

Formation. The Point Pleasant Formation becomes more terrigenous and contains less organic carbon to the south as it comes up onto the Lexington Platform (Wickstrom et al., 1992b). The Trenton Formation is considered stratigraphically equivalent to the Lexington Limestone (Patchen et al., 2006) and its usage is dependent on location. The limestones located in northern and central Ohio are termed the Trenton, while limestone formations located in eastern and southern Ohio are often termed the Lexington.

Point Pleasant Formation:

The Point Pleasant Formation extends northward beneath the Utica shale and is comprised of interbedded light gray to black limestones, brown to black organic-rich calcareous shales, and brachiopod coquina layers. The limestone and shale occur in roughly equal amounts, whereas the siltstone accounts for only a small percentage of the unit. The upper interval of the Point Pleasant Formation is an organic-poor gray shale with generally low TOC content. This interval is considered to be primarily non-reservoir. According to Patchen et al. (2015), the lower interval of the Point Pleasant Formation is an organic-rich calcareous shale with some limestone beds. The organic-rich facies have roughly 40%–60% carbonate content, with TOC ranging from 3% to 8% (average 4%–5%).

Utica shale:

The Upper Ordovician Utica shale is an informal name in Ohio, usually used as a driller's term to refer to the shaley interval beneath the Kope Formation. It is a calcareous, locally fossiliferous organic-rich shale interbedded with limestone deposited in the

Appalachian Basin. It consists of interbedded dark fissile shale and limey shale (10 to 60% calcite) beds. These beds tend to be partly bioturbated and can be fossiliferous (Smith, 2015). The Utica-Point Pleasant interval overlies the Trenton Limestone and sits beneath the Cincinnati Group. TOC content in the Utica shale ranges from less than 1 wt.% to 3.5 wt.%. It typically has an average carbonate content of 25% (Patchen et al., 2015).

METHODOLOGY

XRF was performed on two cores stored in the Horace H. Collins Core Repository of the Ohio Department of Natural Resources (ODNR)-Division of Geological Survey in Delaware, Ohio. The available data already provided from ODNR for the cores were TOC, XRD, well log data, and core descriptions. The general information of the analyzed cores is presented in Table 1.

Table 1. General Core Information

Core Name	Core Number	County (OH)	API Number	Depth of Interval of Interest (ft)
Tracker	6434	Portage	34133244490000	6,141 - 6,474
Farley	6430	Washington	34167297200000	7,782 - 7,998

The cores were cleaned with Deionized (DI) water to remove debris, allowed to air dry and scanned for major and trace element geochemistry using a hand-held x-ray fluorescence (HH-XRF) spectrometer, Thermo-Fisher Niton™ XL3t Ultra Analyzer. Measurements were taken directly on the Farley core at 6 in (15.24 cm) intervals for the Utica shale and 12 in (30.48 cm) for the Point Pleasant Formation and Lexington Limestone. In the Tracker core, measurements were taken at 6 in (15.24 cm) to a depth of 6,311 ft for the Utica shale and then at 12 in (30.48 cm) for the rest of the core. XRF was collected using the factory calibration TestAllGeo mode, with 30 sec each for ‘low,’ ‘high’ and ‘light’ filters, and 90 sec for ‘main’ filter. Both cores were previously half-slabbed to provide a flat surface for readings to be taken on, although this is not a requirement. For data quality control and drift correction on the HH-XRF, every twentieth (10 ft) sample analyzed was an in-house silica standard. XRD and TOC tests performed previously by Core Laboratories (Triad Hunter LLC, 2013) and TerraTek (Schlumberger, 2014) were used in conjunction with the XRF data for further interpretation.

Chemostratigraphy

Chemostratigraphy, as applied in this study, is a method that uses major and trace element geochemistry for the characterization and correlation of strata. XRF is a nondestructive method of collecting elemental data from rock samples. Specifically, this study focused on clay elements (Al, K, Ti, Si), bottom-water, redox-sensitive elements (Mo, Cu, Fe, Ni, S, U, Zn) and carbonate source and phosphate elements (Mg, Ca, Sr, P) and how the elemental changes correlate to chemofacies.

Hierarchical Cluster Analysis (HCA)

HCA was conducted on the geochemical datasets using the statistical software JMP 14 Pro. The analysis was conducted using specific major (Al, K, Si, Ti, Ca, Mg, Fe, S, P, Sr) and trace (Mo, U, V, Ni, Cu, Zn, Th, Zr, Rb, Pb) elements. The concept of cluster analysis is to divide multivariate observations into a number of groups (clusters) where the observations within a cluster are as similar as possible while the differences between the clusters are as large as possible (Templ et al., 2008).

Table 2. Elemental proxies used for the study and their mineral association.

Element	Mineral Indication	Inference	Association
Al, K	Clay minerals	Terrigenous input	feldspars
Si	Quartz	Terrigenous input	clays and feldspars, Si/Al used to distinguish whether biogenic or detrital
Ca, Sr	Calcite	Carbonate material	dolomite
Mg	Dolomite, Ankerite	Dolomitization, dissolution	calcite
Fe	Pyrite, Ankerite	Iron reduction	clay
Ti, Zr		Terrigenous input	eolian deposit
S	Pyrite	Sulfate reduction	organic matter and anoxia
P	Fluorapatite	Remineralization	apatite, phosphate
Ni, Cu, Zn	Organic matter	Productivity	organic matter and anoxia
Mo	Organic matter	Anoxia and euxinia	
U, V		Suboxic and anoxia	

Hierarchical clustering was performed using Wards method (Ward, 1963) which assigns each value a grouping number. The process begins with ‘n’ members in a group. When each group is united, the total number of groups is reduced by ‘n-1’ by comparing one group to another. This is continued until all ‘n’ members are in one group (Ward, 1963). HCA is ideal when you have a large geochemical dataset as it sorts the data into meaningful groups and reduces the dataset into smaller sets of chemically similar clusters.

The clusters are separated by the Euclidean distance which measures the distance between two centroids and was used for this study based on the variables being dependent on one another. A hierarchy of similarity were then built as data measurements were grouped together. The number of clusters chosen were based on the “Thorndike” method, by looking at the cluster similarity at each stage based on the Euclidean distance (Thorndike, 1953). In order to name the clusters, the partitioning index (PI) (Phillips, 1991) of an element was calculated by dividing the average concentration of the element in each cluster by the average concentration in the dataset. Any value greater than or equal to 1 represents an enrichment relative to the PI and below 1 represents a depletion.

RESULTS AND INTERPRETATION

Core description

The two cores include the full section of the Trenton/Lexington Limestones, Point Pleasant Formation and Utica shale. The Farley core from Washington County (OH) has a total of 216 ft (64.8 m) while the Tracker core located in Portage County (OH) has a total of 333 ft (101.5 m).

Trenton/Lexington Limestone:

In core Tracker, the Trenton Limestone is a crystalline, light to medium gray limestone which consists of fragmented shell hash and shale beds randomly distributed throughout the interval. It is 30 ft (9.1 m) thick and contains limestone and shale beds separated by sharp to irregular contacts. The shell hash beds range between two to four inches while the shale beds are typically 0.5 to 3 inches. The fossils present include brachiopod and crinoid fragments. The Lexington Limestone in core Farley is generally dark to light gray, composed of micrite with occasional shale beds present. This interval is 42 ft (12.8 m) thick and characterized by thin shell hash beds capped by medium to dark gray shale. The contacts between the limestone beds and shale range from irregular, titled to sharp. The fossils present include brachiopod and crinoid fragments among others that were a challenge to identify.

Point Pleasant Formation:

The Point Pleasant Formation in core Farley is 113 ft (34.4 m) thick and composed of detrital carbonate grains including corals, shells, ooids, pellets, etc. Thick storm beds are present which contain 50% of carbonate grains that are greater than 0.08 in (2 mm) Grains less than 0.08 in (2 mm) in these storm deposits are mostly calcarenites. The Point Pleasant is generally characterized by dark gray to medium gray shale generally planar laminated and interbedded with storm deposits. The upper portion of this section is extremely fissile while the lower portion of the Point Pleasant is characterized by thicker storm deposits. Bottom contacts between interbeds are abrupt, planar and sometimes wavy. Top contacts vary between abrupt to slight mixing, planar to wavy. Fossils present include crinoids, bryozoans, brachiopods and trilobite fragments. The Point Pleasant Formation is extremely fissile in the upper section and exhibits a gradational relationship with the Utica shale. In core Tracker, the Point Pleasant Formation is 87 ft (26.5 m) thick and medium to dark shales with occasional shell hash beds. The Formation is characterized by planar laminations within the shale but wavy, cross bedded and angular beds are also common. Pyrite is a common fossil replacement mineral and also occurs as laminations. Fractures are common throughout the interval. Fossils present include brachiopods, graptolites, crinoids and trilobites. In both cores, the Point Pleasant Formation displays a gradational relationship with the overlying Utica shale.

Utica shale:

The Utica shale in Farley core is a calcareous-rich, black mudstone of 67 ft (20.4 m) and contains shell hash beds that appear in randomly spaced intervals of less than an inch to four inches thick throughout the core. Contacts found at the base of the storm deposits represent scour surfaces. Bottom contacts between shell hash laminations are mostly wavy with occasional planar contacts while the top contacts are capped with dark gray shale. The shale beds are characterized by micritic laminations that appear wavy to planar. Graptolites are the dominant fossils throughout the Utica shale and Point Pleasant Formation. Other fossils include fragmented bryozoans, trilobites and others however, all of the fossils are detrital. On the other hand, the Utica shale in core Tracker is not characterized by thick storm deposits as observed in the Farley core. The 216 ft (65.8 m) interval is composed of medium to dark gray shale that contains occasional shell hash beds or calcite laminations. Laminations within the core are typically planar but can be cross-bedded and wavy for carbonate layers. Pyrite is common throughout the shale while fractures cross-cut the core in several locations. The fossils present include trilobites, brachiopods and graptolites.

Mineralogy and TOC

Whole rock minerology collected with XRD show the primary mineral constituents in both cores are quartz, carbonates (calcite and dolomite-Fe rich), clays (predominantly illite) (Figure 4) and pyrite with fluorapatite occurring in small quantities. The sCore lithofacies classification scheme for organic mudstones (Gamero et al., 2012) reveals the different lithofacies present in the Utica shale, Point Pleasant Formation and the Trenton/Lexington Limestones in the two cores (Figure 3). The formations in both cores appear to contain slightly varying lithofacies which was used to better understand the depositional conditions. The TOC displays a general trend in both cores where it decreases from the Point Pleasant Formation into the Utica shale. However, the Farley core, average TOC values range from 0.1 wt.% to 0.6 wt.% in contrast to 0.2 wt.% to 5 wt.% in the Tracker core.

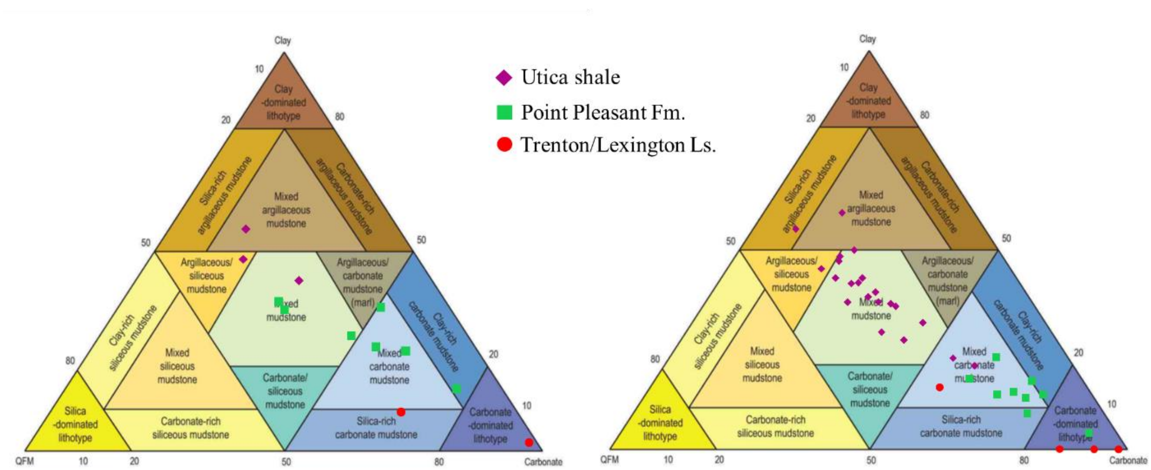


Figure 3. sCore lithofacies classification scheme for organic mudstones in core Farley (left) and core Tracker (right). Modified from Gamero et al. (2012)

XRF Analysis

The results of this study focus on the stratigraphic plots and general trends of major and trace metal concentrations in both cores. Overall, there are noticeable geochemical variations within the formations which are used to understand provenance, paleoredox conditions and organic matter preservation during deposition.

Major Element Geochemistry

The major elements selected to plot for interpretations were detrital proxies (Al, K, Si, Mg, Fe, S) and carbonate and phosphate proxies (Ca, Sr, P). In the Farley core, there is a major shift in element concentration occurring at 7,860 ft (2,395.7 m) between the Utica shale and Point Pleasant Formation unlike the proposed boundary between the two formations which does not record any significant shift in elemental concentration (Figure 4). The transition from the Point Pleasant Formation into the Utica shale at this depth is marked by a sharp increase in terrigenous influx (Al, K, Si, Mg and Fe) with a corresponding decrease in carbonate input (Ca and Sr).

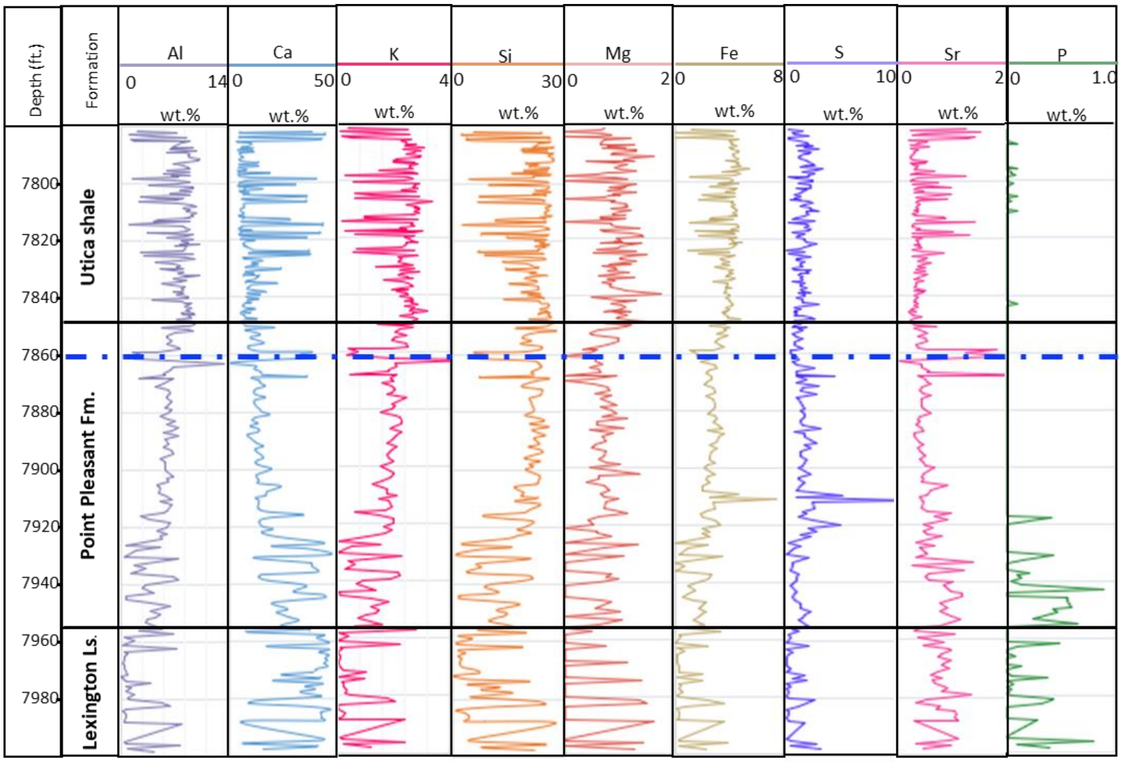


Figure 4. Stratigraphic plot of major element concentrations with formation boundaries (black lines) in the Farley core, Washington Co. (OH). The blue dash line represents a major shift in elemental concentrations at the Utica-Point Pleasant transition.

In the Tracker core, the lower Utica shale displays a gradual increase in terrigenous influx (Al, K, Si, Mg and Fe) with a corresponding decrease in carbonate and phosphate input (Ca, Sr, P) until 6,321 ft (1,926.6 m). This depth marks a shift in elemental concentration from the Point Pleasant Formation into the Utica shale upsection in contrast to the proposed boundary between the two formations (Figure 5). This boundary represents basinal changes during deposition which will be discussed later.

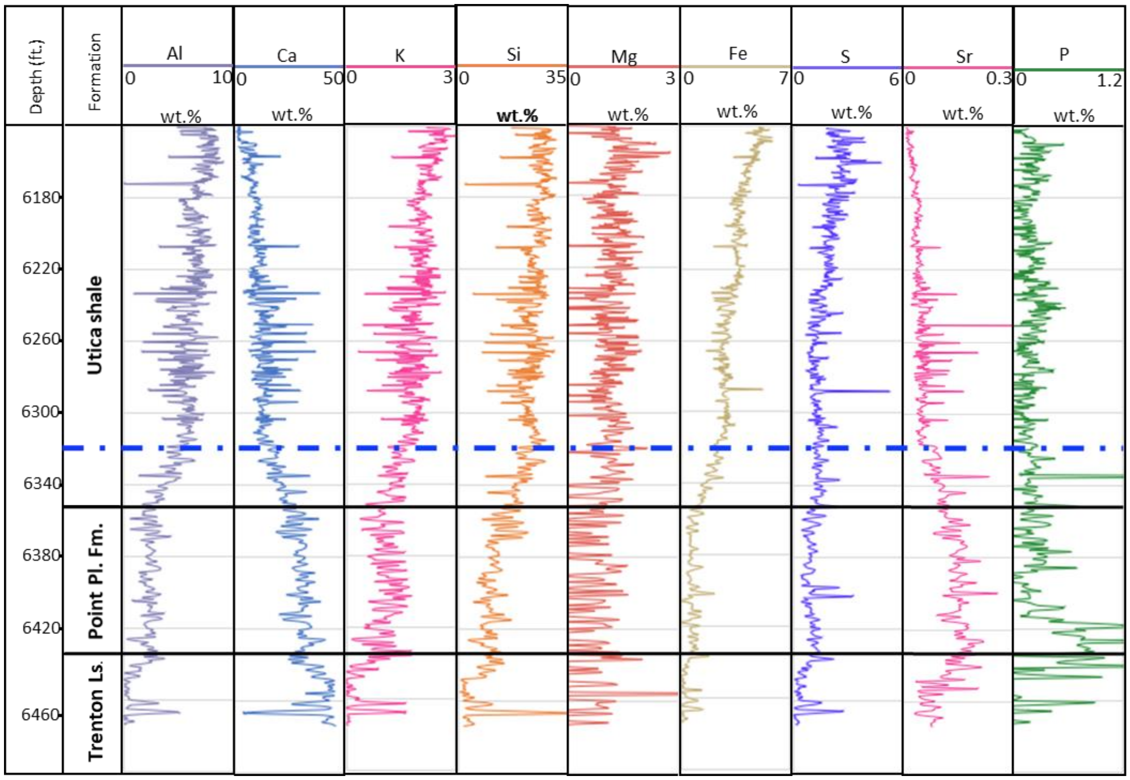


Figure 5. Stratigraphic plot of major element concentrations with formation boundaries (black lines) in the Tracker core, Portage Co. (OH). The blue dash line represents a shift in elemental concentrations at the Utica-Point Pleasant transition.

Average Al concentrations of Utica shale, Point Pleasant Formation and Lexington Limestone samples in the Farley core range between 2 and 7 wt.%, compared to average shale with a value of 8.8 wt.% (Wedepohl, 1971). The Utica shale samples display the highest mean Al concentration, and the Lexington samples are characterized by the lowest Al concentration. In the Tracker core, Al appears to be slightly lower than observed in the Farley core, ranging from 1 and 6 wt.%. Overall, the Utica, Point Pleasant and Trenton/Lexington Limestone are enriched in Ca compared to average shale by an order of magnitude (Table 3). Thus, they are typically depleted in other elements compared to average shale (Pietras & Spiegel, 2018).

Table 3. Average xrf-based concentrations of detrital proxies in the Farley and Tracker cores compared to average shale values (Pietras & Spiegel, 2018; Wedepohl, 1971; Tribovillard et. al., 2006).

			Elements					
	Formation	Samples	Al (wt.%)	Ca (wt.%)	K (wt.%)	Si (wt.%)	Zr (ppm)	Mg (wt.%)
Farley	Utica	137	7.3	11.2	2.2	22.1	102.9	0.9
	Point Pl.	97	5.2	17.8	1.6	19.1	77.9	0.6
	Lexington	38	1.8	34.2	0.5	0.79	43.2	0.3
Tracker	Utica	400	6.1	12.2	1.9	23.3	122.9	1.2
	Point Pl.	88	2.4	30.5	0.5	10.8	44	0.5
	Trenton	31	0.9	40	0.6	5.6	20.5	0.6
Average shale			**8.8**	**1.6**	**3**	**27.5**	**160**	**1.6**

Trace Element Geochemistry

The trace elements selected to identify the general trends and shifts occurring upsection in both cores were redox proxies (Mo, V, U) and productivity proxies (Zn, Ni, Cu). In the Farley core, the trace elements are generally below detection limits except for Cu which displays a decrease in concentration in the lower Point Pleasant Formation into the Lexington Limestone (Figure 6). The Tracker core has a high abundance of trace elements and displays a general trend of increasing concentration upsection with some sections showing higher concentrations than others, indicating zones of productivity and anoxia (Figure 7).

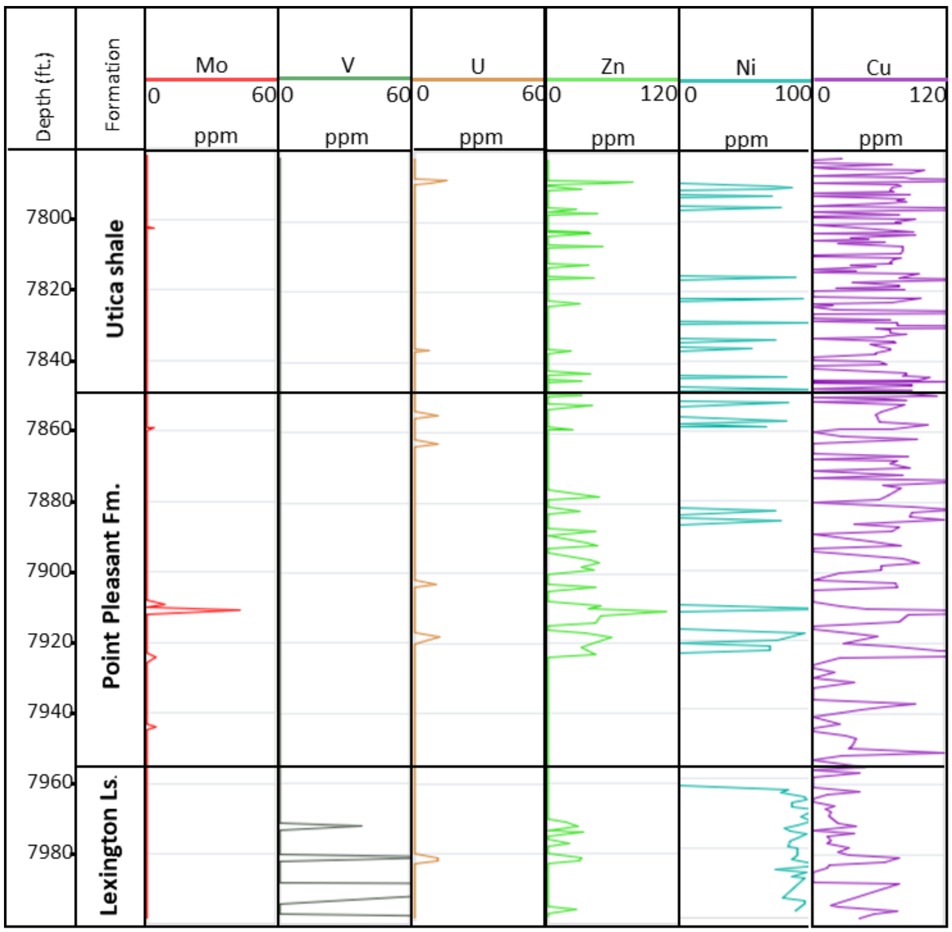


Figure 6. Stratigraphic plot of trace metal concentration in the Farley core, Washington County (OH).

In order to interpret paleoredox conditions, the trace elements were normalized using enrichment factors (EF) to assess whether they are relatively enriched or depleted relative to ‘average shale’ (Table 4) (Tribovillard et al., 2006, Wedepohl, 1971). The ‘average shale’ value represents the average abundance of an element in pelagic clays sampled from different oceans. Thus, EF values are only calculated for the Utica-Point Pleasant interval due to the abundance of shale beds in the interval. Based on the enrichment of carbonates and depletion of Al in the Trenton/Lexington Limestones, they are not shales therefore EF’s for these formations would produce inaccurate values.

Aluminum was used to normalize the concentrations due to its inability to move during diagenesis (Equation 1).

$$EF = (X_{element}/Al)_{(sample)} / (X_{element}/Al)_{(average\ shale)} \qquad \text{Equation 1}$$

Where X is the element of interest in ppm, and Al is reported in ppm. If EF is greater than 1, then the element is enriched relative to average shale and if less than 1, it is depleted (Tribovillard et al., 2006).

Table 4. Average XRF concentrations of trace metals in the Farley and Tracker cores relative to average shale (Wedepohl, 1971; Tribovillard et. al., 2006).

			Elements (ppm)						
	Formation	Samples	Mo	U	V	Ni	Cu	Zn	Al
Farley	Utica	137	0.0	0.2	0.0	6.7	7.3	54.0	72,538
	Point Pl.	97	0.6	0.4	0.0	7.7	9.7	47.8	51,760
	Lexington	38	0.0	0.6	9.7	73.5	4.5	4.5	18,141
Tracker	Utica	400	2.8	4.7	56	104.1	43.7	78.1	60,565
	Point Pl.	88	0.8	0	6.8	93.2	24.7	27.6	23,891
	Trenton	31	0	0.7	3.1	90.2	4.0	13.1	9,205
Average shale			**1.3**	**3**	**130**	**68**	**45**	**95**	**88,900**

The EF values of Mo in the Tracker core are slightly enriched in the upper section of the Utica shale compared to the other trace elements (Figure 8). The EFs of the trace elements display a sharp increase in value at 6171.6 ft (1881.1 m) with the exception of U. All of the trace elements with the exception of U display a gradual increase in EF's from the Trenton/Lexington to the contact with the Point Pleasant Formation. Overall, the EF's in the Tracker core are enriched in all of the trace metals and depleted in the Farley core.

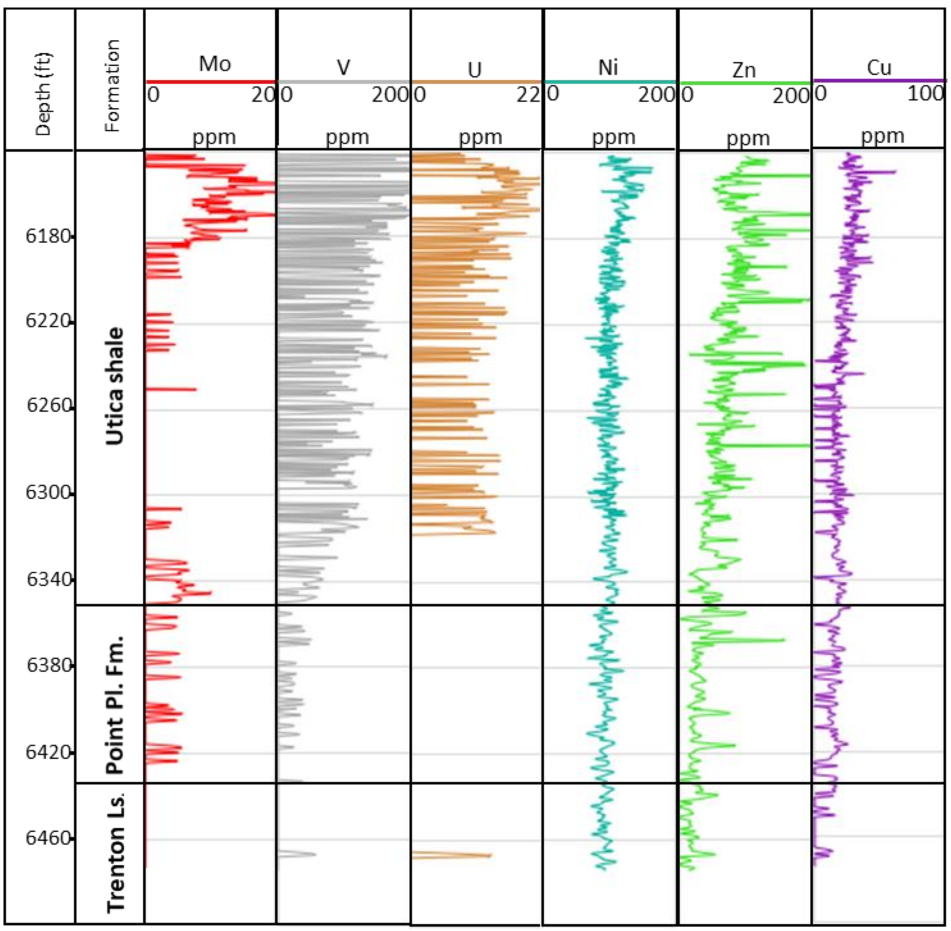


Figure 7. Stratigraphic plot of trace metal concentrations in the Tracker core in Portage Co. (OH).

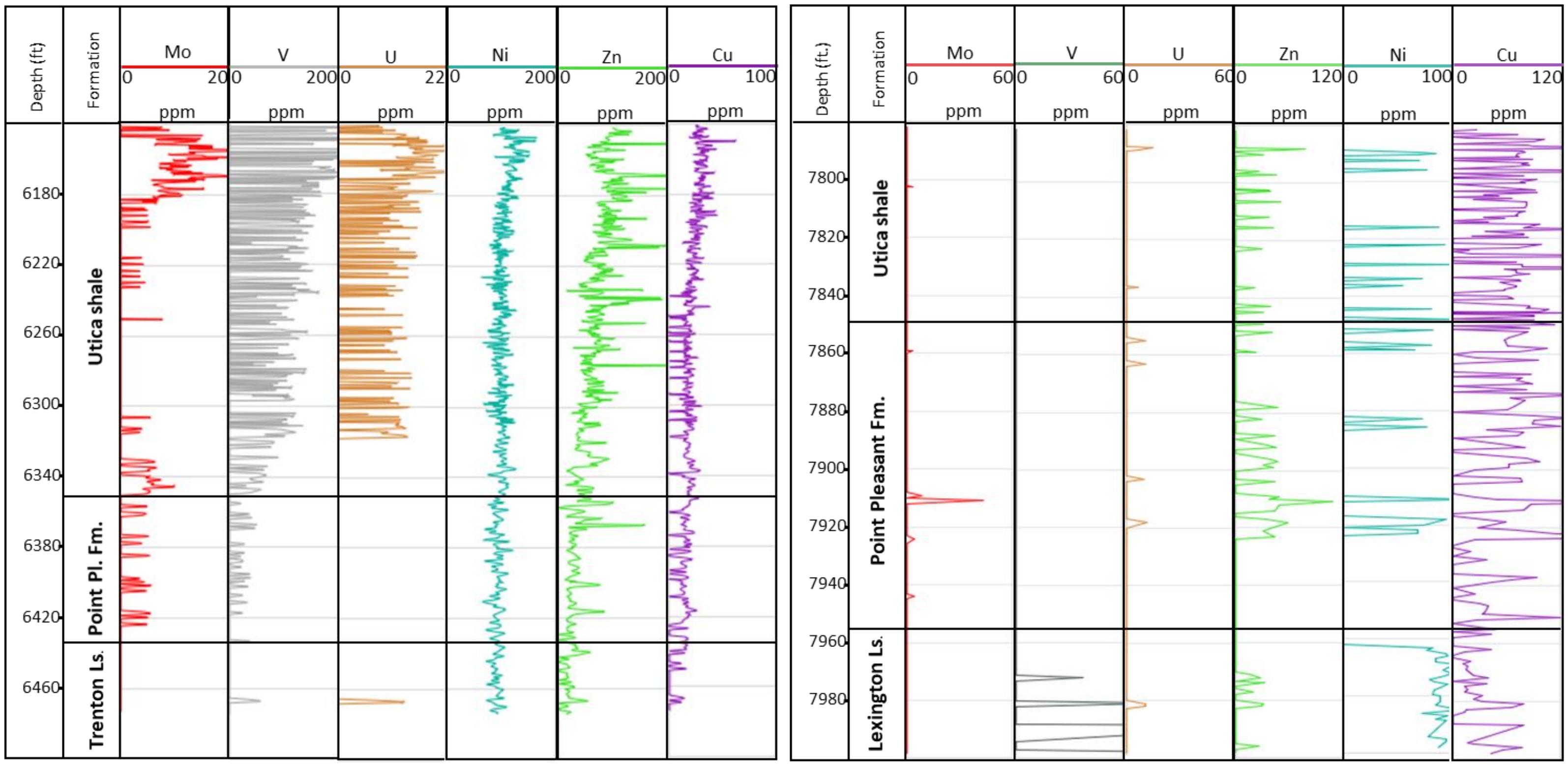


Figure 8. Stratigraphic plot of enriched factors (EF's) calculated for trace elements in the Utica-Point Pleasant interval in the Tracker core (right) and Farley core (left).

Cross-Plot Analyses

Elemental cross-plots were used to determine whether an element is controlled by detrital flux using Al due to its detrital origin and ability to be immobile during diagenesis. If a positive correlation is observed, then the element is of detrital origin and cannot be used for paleoredox analysis (Tribovillard et al., 2006).

In Figure 9, cross-plots of Si, Fe, Mg, K, Zr and Ti versus Al in the Farley core illustrate a positive correlation showing their association with terrigenous-sourced clay minerals. Iron has two separate trends of data, indicating contributions from other mineral constituents such as illite, pyrite and dolomite, which is consistent with XRD results. Silicon also displays two data trends indicating the presence of biogenic or detrital quartz possibly in the Point Pleasant Formation. To be able to distinguish between biogenic and detrital quartz, the elemental ratio of Si/Al is used. High Si/Al ratio and low detrital proxies Ti, Zr or K, indicate biogenic quartz. Calcium has a negative relationship to Al indicating that the elements in the formation have different sediment provenance. In Figure 10, cross-plots in the Tracker core display similar relationships as observed previously with the exception of Mg and Ti. Potassium concentration in the Point Pleasant Formation appears to have two separate trends. Deviation from the trend indicate contributions from different minerals associated with this element other than clay, which in this case is K-feldspar.

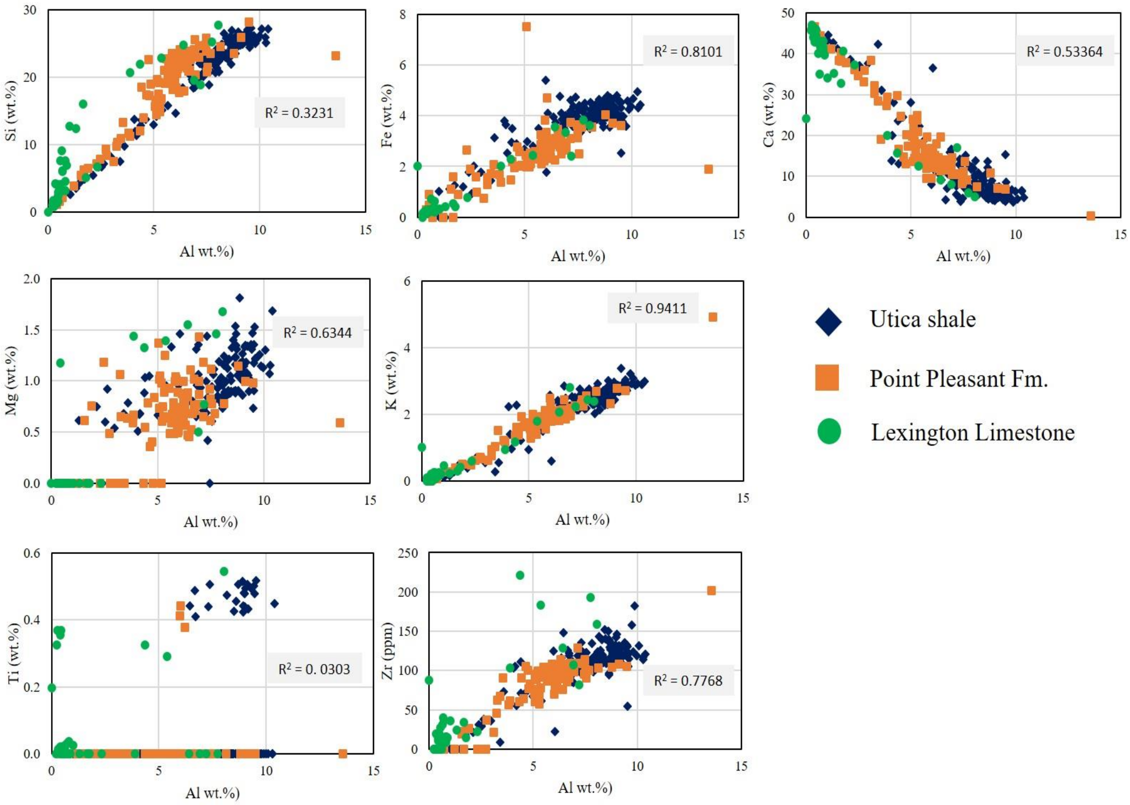


Figure 9. Cross-plots of detrital proxies in the Farley core, Washington Co. (OH).

In using simple raw elements K, Zr and Al are used as proxies for transgression and regression (Coleman & Jordan, 2018). Decreases in, Zr, K and Al indicate a relative sea-level rise because it shows the detrital sediment source is moving further from the distal basin. Increases in these proxies correspond to relative sea-level fall as it indicates that the detrital sediment source is closer to the distal basin (Coleman & Jordan, 2018). Based on this observation, the two cores display general increase in detrital proxies from the Point Pleasant Formation into the Utica shale suggesting that the Utica shale was deposited close to the basin. Thus, the beginning of the Utica shale deposition in the Farley core is characterized by a drop in sea-level which is marked by the high spike of detrital proxies at 7,863 ft (2,396.6 m) in contrast to the established boundary at 7,849 ft (2,392.4 m). This is followed by a sharp decrease in concentration of these proxies indicating the sudden rise in sea-level then a subsequent increase in concentration (Figure 4).

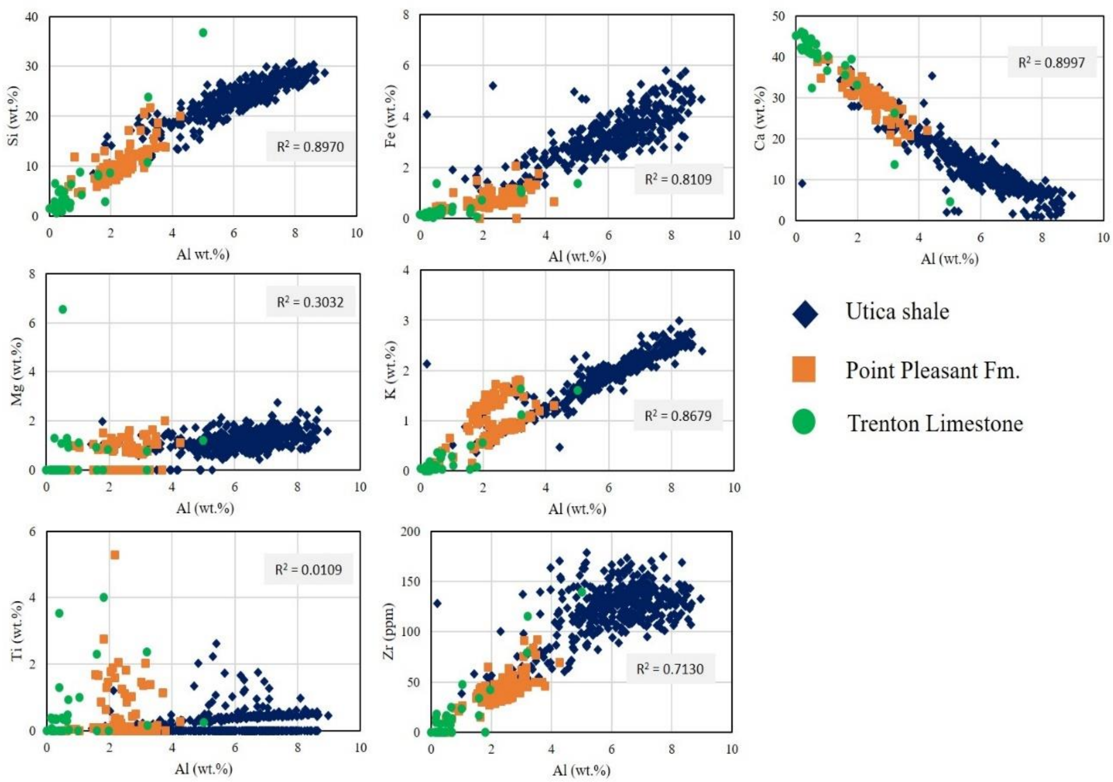


Figure 10. Cross-plots of detrital proxies in the Tracker core, Portage Co. (OH).

Eustatic fluctuations are responsible for the rapid change in concentration of the detrital proxies in the Utica shale. In the Tracker core, the gradual increase in detrital proxies indicate that sea-level appeared to have dropped gradually during sedimentation. Based on the mineralogy, the Point Pleasant Formation displays increasing clay content and decreasing limestone content as it transitions into the Utica shale. This same relationship is observed in the concentration of detrital proxies from the Point Pleasant Formation into the Utica shale suggesting that beginning of deposition of the Utica shale begins at 6,321 ft (1,926.6 m). as opposed to the established depth of 6,356 ft (1,937.3 m) (Figure 5).

HCA-derived Chemofacies

The analysis performed on all the formations in both cores revealed a total of five clusters which are hereafter referred to as chemofacies. The raw values for specific major (Al, K, Si, Ti, Ca, Mg, Fe, S, P, Sr) and trace (Mo, U, V, Ni, Cu, Zn, Th, Zr, Rb, Pb) elements were used for the analysis. The partitioning index (PI) of an element was calculated for each chemofacies, and any value greater than or equal to 1 represents an enrichment relative to the PI and below 1 represents a depletion. The elements in each chemofacies were ranked from the most enriched to the most depleted relative to their average value (Table 5).

Chemofacies '1', contains the largest group of samples compared to the other chemofacies and is enriched in productivity, anoxia and detrital proxies. Elements associated with carbonate sources are particularly depleted in this chemofacies. Vanadium and U are the most enriched elements with a PI of 1.72 while Mo is extremely depleted which can be associated with bottom-water anoxia during deposition. The enrichment of Ni, Cu and Zn represent high productivity in the water column and organic matter preservation under anoxic conditions (Tribovillard et al., 2006).

Chemofacies ‘2’ shares similarities with chemofacies ‘1’ in that it is enriched in productivity, anoxia and detrital proxies and depleted in carbonate proxies. It is distinguished from chemofacies ‘1’ by a slightly higher enrichment of geochemical proxies. The enrichment of Mg in this chemofacies represents samples with dolomite as the dominant carbonate mineral other than calcite. It contains three times more of U and V in chemofacies ‘1’ as well as the most enriched Mo in contrast to the other chemofacies. These elements reflect bottom-water euxinia present during deposition.

Chemofacies ‘3’ is enriched in detrital and chalcophile proxies. The most notable major element enrichments within this chemofacies are Al, K, Si, Fe and S representing samples where clay minerals are the most abundant minerals and calcite is depleted. This chemofacies is present in the Farley core throughout the Utica shale and upper Point Pleasant Formation and absent in the Tracker core.

Chemofacies ‘4’ is enriched in phosphate and carbonate proxies. This occurs mainly in the Tracker core, most likely representing samples where fluorapatite is present other than carbonate minerals, which is consistent with XRD analyses. The elements Ti and Th are also enriched, reflecting its association with terrigenous sediment sources. Phosphorous is the most enriched element with a PI of 2.14. Nickel is the notable productivity proxy in this chemofacies which is associated with the presence of micronutrients in the water column. Phosphorous enrichment can be used as a proxy for high organic matter supply, however high productivity is not always a prerequisite (Tribovillard et al., 2006).

Chemofacies ‘5’ is enriched in carbonate proxies, the highest PI %Ca and %Sr of 2.42 and 1.41, respectively, relative to any of the chemofacies. It represents samples mostly dominated by calcite and depleted in elements associated with terrigenous sources. Redox sensitive trace metals are also extremely depleted in this chemofacies due to the dilution of calcite-rich samples.

Table 5. Chemofacies identified in both cores showing clustering information of selected geochemical proxies. Chemofacies were identified using the PI to indicate relative enrichment/depletion (Phillips, 1991).

Chemofacies 1		Chemofacies 2		Chemofacies 3		Chemofacies 4		Chemofacies 5	
n = 268		n = 75		n = 195		n = 179		n = 75	
element	PI	element	PI	element	PI	element	PI	element	PI
		Mo	7.58						
V	1.72	U	4.18						
U	1.72	V	3.59						
Cu	1.52	Pb	2.95						
Ni	1.38	Cu	2.31						
Zr	1.33	Zn	1.94						
Rb	1.28	%S	1.79						
%Mg	1.28	Ni	1.67						
Th	1.25	%Fe	1.61						
%Si	1.23	%Mg	1.47						
Zn	1.20	Rb	1.44	%Al	1.37				
%Ti	1.19	%Si	1.35	%K	1.34				
%Fe	1.17	%Al	1.34	%Fe	1.30	%P	2.14		
%Al	1.15	%K	1.32	%Si	1.14	%Sr	1.90		
%K	1.15	Zr	1.29	%S	1.11	%Ti	1.65		
Pb	1.08	%Ti	1.27	Zr	1.10	%Ca	1.59		
%S	1.07	%P	1.24	Rb	1.09	Th	1.30	%Ca	2.42
%P	1.04	Th	1.08	Pb	1.08	Ni	1.22	%Sr	1.41
%Sr	0.71	%Sr	0.44	%Mg	0.99	Cu	0.90	Th	0.83
%Ca	0.64	%Ca	0.41	Zn	0.98	%S	0.75	Ni	0.75
Mo	0.35			%Ca	0.63	%Mg	0.72	%Ti	0.39
				%Sr	0.62	%Si	0.68	%S	0.29
				Th	0.42	Zn	0.66	%Mg	0.25
				%Ti	0.27	Rb	0.66	%Si	0.24
				Cu	0.24	Mo	0.64	%Al	0.20
				Ni	0.11	%K	0.64	Zn	0.19
				U	0.08	Zr	0.63	%Fe	0.18
				%P	0.06	%Al	0.56	%P	0.18
				Mo	0.06	%Fe	0.50	Rb	0.14
				V	0.00	Pb	0.41	Zr	0.13
						V	0.34	%K	0.13
						U	0.02	Pb	0.08
								Cu	0.07
								Mo	0.06
								U	0.00
								V	0.00

Element - Proxy
- Ni, Cu, Zn – Paleo-productivity
- Fe, S, Pb – Chalcophile
- Mo, U – Paleo-redox
- Ca, Mg, Sr – Carbonate
- Al, K, Rb, Zr, Nb, Th, Si, Ti – Detrital
- P – Phosphate

Enrichment

Depletion

Chemostratigraphy

For the purpose of this study, chemostratigraphic zones were identified using selected major elements, trace metals, TOC and chemofacies plotted with depth (Figures 11 & 12). These zones were then used to correlate the Farley core to the Tracker core, which are 106 mi (171 km) apart. This study does not incorporate structural controls which could be affecting the formations. Instead, the study focuses on using chemozones to characterize and correlate the formations in both cores.

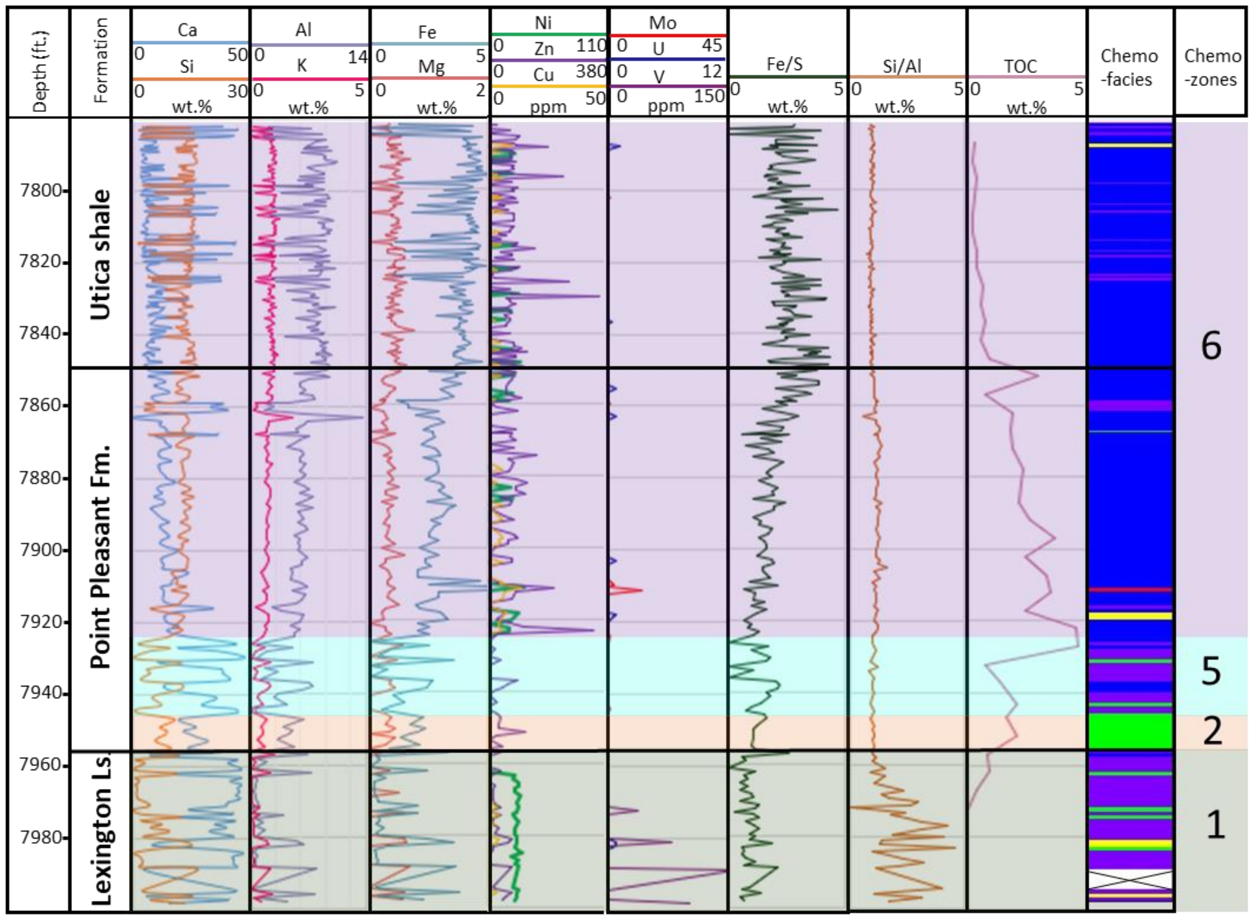
In the Farley core, the Lexington Limestone is primarily chemofacies ‘5’ interbedded with thin beds of chemofacies ‘4’. Chemofacies ‘5’ is dominant in this formation due to the high abundance of calcite in this section and totals ~30 ft (~9.1 m). The Point Pleasant Formation is dominated by chemofacies ‘3’ however the lower section of this formation is characterized by chemofacies ‘4’ and ‘5’. Both chemofacies schemes define intervals with high amounts of P and Ca. Chemofacies ‘4’, which is ~10 ft (~3 m) thick, separates the Lexington from the Point Pleasant and is characterized by the enrichment of P in this section. This interval is also characterized by a layer of chemofacies ‘1’, which is located between 7,918 ft (2,413.4 m) – 7,920 ft (2,414 m) and a layer of chemofacies ‘2’ located between 7,911 ft (2,411.2 m) – 7,912 ft (2,411.6 m). Chemofacies ‘3’ totals ~68 ft (~20.7 m). Similar to the Point Pleasant Formation, the Utica shale is dominated by chemofacies ‘3’, ~53 ft (~16 m) thick, with sporadic small thin layers of chemofacies ‘5’ distributed throughout the section. Chemofacies ‘5’ correlates to the shell hash beds located in the Utica shale.

Similar to the Farley core, the Trenton Limestone in the Tracker core displays the same relationship but has a 10 ft (~3 m) thick bed of chemofacies ‘4’ at the top of the formation. Chemofacies ‘5’ in the Tracker core totals ~15 ft (~4.6 m). Chemofacies ‘4’ is located throughout the Point Pleasant Formation. The Utica shale in the Tracker core is characterized by chemofacies ‘1’, ‘2’ and ‘5’. The lower section of this formation is dominated by chemofacies ‘4’ interbedded with thin layers of chemofacies ‘1’. Chemofacies ‘1’ dominates the Utica shale from ~6,145 ft (~1,873 m) to ~6,320 ft (~1,926.3 m) and is defined by interbedded thin layers of chemofacies ‘4’. The upper section of the Utica shale from ~6,151 ft (~1,874.8 m) to ~6,180 ft (~1,883.6 m) is primarily chemofacies '2’ with thin beds of chemofacies ‘1’. In total, six chemozones were identified based on the correlation of chemofacies between the two cores. The Farley core consists of chemozones 1, 2, 5, 6 and 7 (Figure 9) while chemozones 1-4 exist in the Tracker core (Figure 10).

Chemozones

Chemozone 1 is located in the Trenton/Lexington Limestones in both cores and consists of chemofacies ‘1’, ‘4’ and ‘5’. This zone is generally marked by extremely low abundance of major elements (Al, K, Fe and Mg) and an inverse relationship between Ca and Si. In the Farley core, the spikes in Al, Fe, K correspond to the shale beds present in the Lexington Limestone. This is only observed at 6,437 ft (1,971.1 m) in the Tracker core. The redox sensitive trace metals (Mo, U, and V) are generally depleted in this zone which may be related to oxygenated conditions in both cores. In the Farley core, the high spikes of V correspond to spikes of Al, K, Fe and Mg indicating oxic to suboxic bottom-water conditions. The dominance of chemofacies ‘5’ highlights the high calcite content in this zone which corresponds to the thick limestone beds identified in both cores. This zone is further characterized by extremely low TOC content which may be related to the dilution of organic matter by Ca.

Chemozone 2 is predominantly chemofacies ‘4’. Chemozone 2 occurs throughout the Point Pleasant Formation and between ~6’330 ft (~1’929.4 m) to ~6’440 ft (~1’962.9 m) at the base of the Point Pleasant in the Tracker core. There are slight enrichments in the concentration of detrital proxies, which is confirmed with the presence of clay proxies, although calcite remains the dominant mineral. The enrichment of P in chemofacies ‘4’ in this zone correlates with the abundance of fluorapatite in the Tracker core. In the Farley core, this only occurs in the thick shell hash bed found at the base of the Point Pleasant Formation from ~7,949 ft (~2,422.9 m) to ~7,953 ft (~2,424.1 m) and may not necessarily be related to calcite. Chemozone 2 corresponds to the most productive zone in the Tracker core in contrast to the Farley core. The redox sensitive trace metals (Mo and V) and productivity proxies (Ni, Cu and Zn) are depleted in the Farley core but enriched in the Tracker core, indicating deposition of the Tracker core in a water column high in productivity under euxinic conditions.



Chemofacies 1 Chemofacies 2 Chemofacies 3 Chemofacies 4 Chemofacies 5

Figure 11. Chemostratigraphic zones present in the Farley core using selected geochemical elements and chemofacies

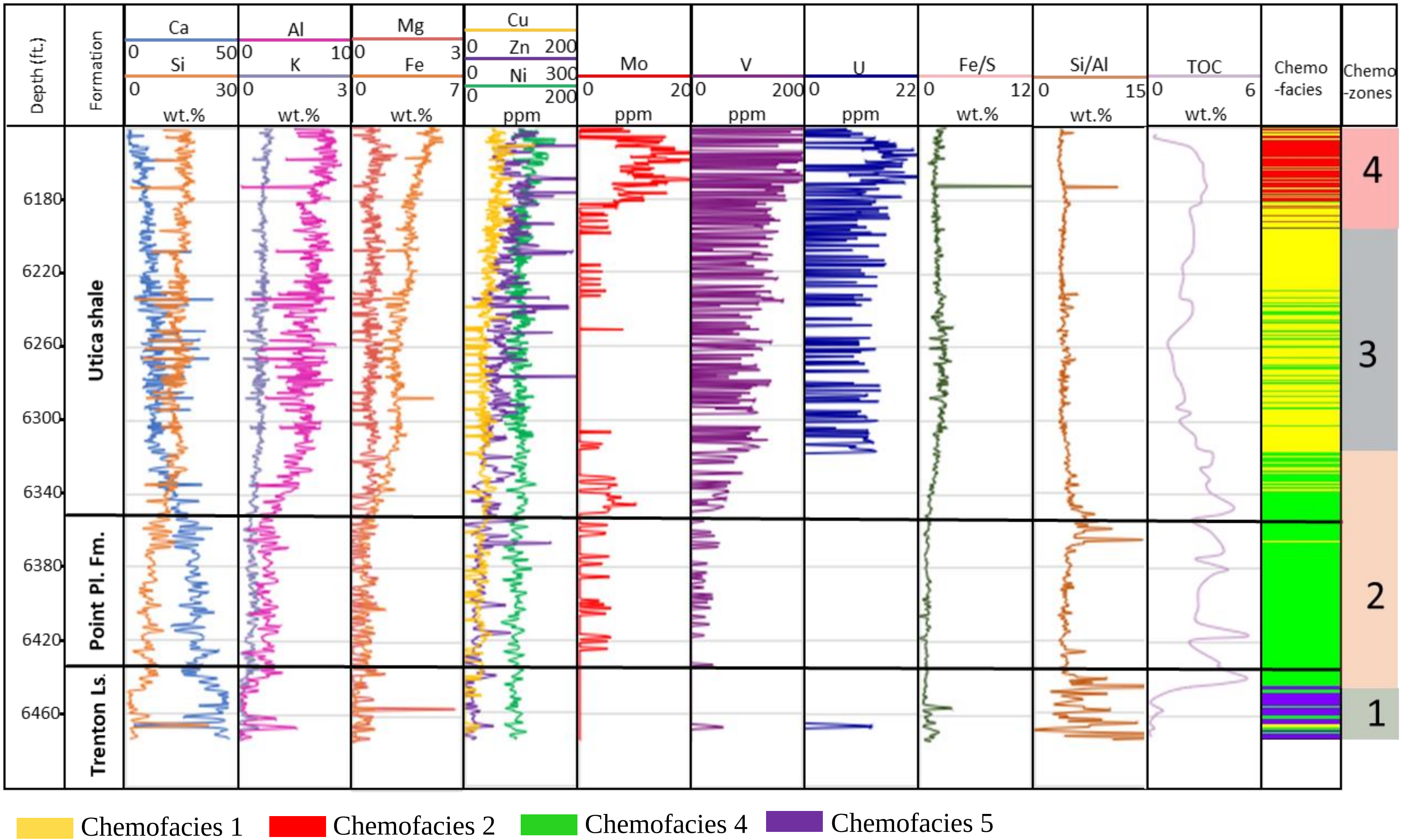


Figure 12. Chemostratigraphic zones present in the Tracker core using selected geochemical elements and chemofacies.

Chemozone 3 consists of chemofacies ‘1’ and ‘4’. This zone occurs only in the Tracker core from ~6,180 ft (~1,883.7 m) to ~6,330 ft (~1,929.4 m) and is characterized by generally high abundance of major elements (Al, K, Fe and Mg) and low Ca. This is confirmed with the enrichment of clay minerals throughout the zone. However, the thin layers of chemofacies ‘4’ correspond to the high spikes of Ca which is identified as shell hash beds present in the Utica shale in the Tracker core. The abundance of Fe/S also reflects the pyrite enrichment throughout the zone. Chemozone 4 represents anoxic bottom water conditions based on the enrichment of V and U with average TOC of 2.0 wt%.

Chemozone 4 is predominantly chemofacies ‘2’ and is present only in the Tracker core. This zone is located at the top of the Utica shale from 6,141 ft (1,871.8 m) to ~6,180 ft (~1,883.7 m). It is enriched in major elements (Al, K, Fe and K) and depleted in Ca which is confirmed by the abundance of clay minerals in this zone. The enrichment of redox sensitive trace metals and productivity proxies (Mo, U, V, Ni, Cu and Zn) suggest deposition in euxinic bottom waters. The abundance of Fe/S corresponds to the pyrite enrichment observed in the core. This zone is characterized by average TOC of 2.2 wt.%.

Chemozone 5 consists of chemofacies ‘3’, ‘4’ and ‘5’ and is present in the Farley core at the lower section of the Point Pleasant Formation from ~7,961 ft (~2,426.5 m) to ~7,951 ft (~2,423.5 m). This zone is characterized by low abundance of major elements (Al, K, Fe and Mg) and an inverse relationship between Ca and Si. High Ca correlates to the high abundance of carbonates in the zone which is identified as the gray shales present.

This zone is generally depleted in trace elements and characterized by average TOC of 2.3 wt.%.

Chemozone 6 is predominantly chemofacies ‘3’ but includes chemofacies ‘1’, ‘2’ and ‘5’. This zone begins from ~7,921 ft (~2,141.3 m) in the Point Pleasant Formation and throughout the Utica shale in the Farley core. At 7,860 ft (2,395.7 m), chemofacies ‘5’ separates this zone into upper Chemozone 6 (Utica shale) and lower Chemozone 6 (Point Pleasant Formation). The upper zone, which contains average TOC of 0.6 wt.%, is mostly chemofacies ‘3’ with thin layers of chemofacies ‘5’ representing the storm beds identified in the core. The lower zone contains average TOC of 2.8 wt.%. Overall, the zone is characterized by enrichment of major elements (Al, K, Fe and Mg) and low Ca which is consistent with XRD analyses indicating high clays present.

DISCUSSION

Depositional Environment

This study focuses on interpreting the geochemical proxies to analyze the depositional environment of the Utica shale Play. The selected proxies for discussion are used to interpret detrital input and paleoredox conditions. Detrital input analysis is used in identifying general shifts in sedimentation to determine provenance changes and relative sea levels using major elemental ratio plots. These changes also reflect the role of detrital input in the burial and dilution of organic matter. Trace metal concentrations are commonly used as paleoredox and paleoproductivity proxies which may provide information about the bottom-water conditions (Pietras & Spiegel, 2018). Due to the general depletion of trace metals in the Farley core, bottom-water conditions are only evaluated using trace metal EF’s in the Tracker core.

Detrital Input Analysis

Decreased Ca concentration and increased Al from the Utica-Point Pleasant interval record a shift from the calcareous mudstones of the Point Pleasant to the siliciclastic-rich mudstones of the Utica shale. A likely source of this increased clay content is the sediment flux from the ensuing taconic orogeny. Detrital influx can be analyzed using detrital elemental proxies as stratigraphic plots, elemental ratios or cross-plots.

Elemental ratios of K/Al, Si/Al, Zr/Al, Ti/Al, Zr/Nb and Mg/Al are also used to analyze the detrital input into the basin during deposition and proxies for grain size distribution. Decreasing K/Al, Si/Al, Zr/Al, Ti/Al and Mg/Al from the Point Pleasant into the Utica shale highlight changes in detrital influx in the bulk composition of siliciclastic detritus in the Utica-Point Pleasant interval. The issue with using these ratios is that it doesn't specify whether variations are due to fluctuations in Al concentrations or the other elements. Rather, what we infer from it is that it indicates relative changes in bulk elemental concentrations and differences in mineral composition.

Transitioning into the Utica shale from the Point Pleasant Formation in the Farley core, the elemental ratios do not show a distinct change in values. There is a change in detrital input from the lower section of the Point Pleasant indicating a shift in the bulk composition of detritus deposited at a constant rate (Figure 13). The upper section of the Utica shale appears to have minor fluctuations due to the slight decrease in ratios. However, there is a slight overall decrease in K/Al, Si/Al, Zr/Al and Zr/Nb from the Point Pleasant Formation into the Utica shale. Similarly, the Utica shale in the Tracker core is not significantly affected by changes in detrital input. The transition from the Point Pleasant Formation into the Utica shale is observed at 6,335 ft (1,930.9 m) with increases in Zr/Al and Zr/Nb and corresponding decreases in the other proxies. This represents a major shift in detrital input in the deposition of the Utica shale (Figure 15).

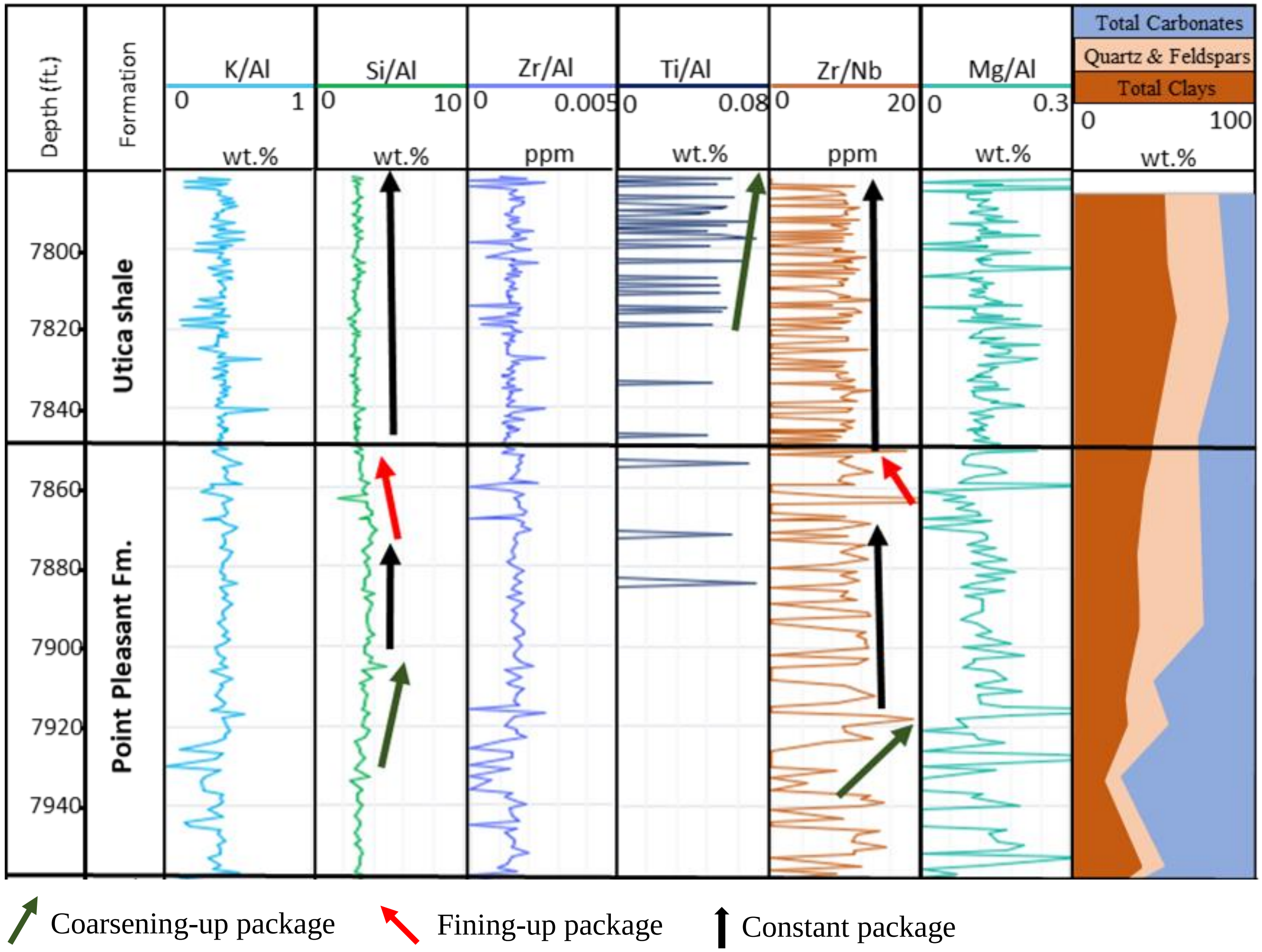


Figure 13. Stratigraphic plots of various detrital influx proxies in the Farley core, Washington Co. (OH).

Ti/Al, Zr/Nb and Si/Al are used as proxies for grain size because Ti, Zr and Si are mostly associated with coarser terrigenous detritus with respect to Al while Al and Nb are commonly associated with clay minerals. Titanium in most pelagic marine sediments is linked to eolian sources while Si is attributed to terrigenous sources that have a fluvial or volcanic origin. (Wokasch, 2014). Using Zr/Nb, Si/Al and Ti/Al as grain size proxies can be also be used to identify eustatic fluctuations during deposition. Increases in Ti/Al correspond to regression cycles as eolian deposits are typically located close to the shoreline. Increases in Si/Al relative to Ti/Al represents deposition deeper into the basin since the source of Si can be associated with detrital or biogenic quartz (Figure 14) (Wokasch, 2014). The coarsening- and fining-upward packages identified in the detrital ratio plots are hereby used as proxies for relative sea-level changes.

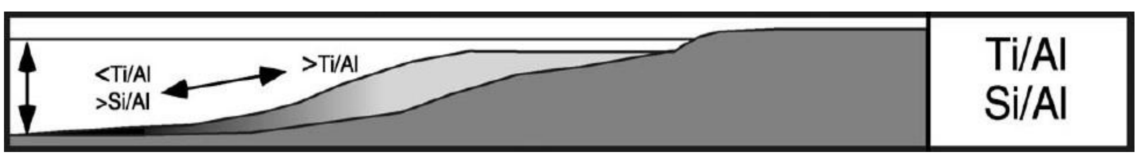


Figure 14. Detrital delivery into the basin influenced by changes in Ti/Al and Si/Al. Modified from Sageman et al. (2003).

The overall decrease in Si/Al and Zr/Nb from the Point Pleasant Formation to the Utica shale in the Farley core suggest deposition further from the shoreline. At 7863 ft (2396.6 m), there is a minor fining-up package which is interpreted as relative sea-level rise between the Point Pleasant Formation and the Utica shale (Figure 13). As identified earlier, this may be the actual start of the deposition of the Utica shale. The Utica-Point

Pleasant interval is characterized by two minor coarsening- and fining-up packages in the Si/Al and Zr/Nb plots with constant packages identified throughout. The one minor coarsening-up package in the Ti/Al plot in the upper section of the Utica shale indicates that deposition was closer to the shoreline. This corresponds to the increased frequency of shell hash beds in this section as a result of the frequent storm invasions bringing in the fine-grained thick shell hash beds observed.

In the Tracker core, three minor coarsening- and fining-up packages are identified in the Utica-Point Pleasant interval. Unlike the Farley core, the Ti/Al coarsening-up packages are much more prominent in the Point Pleasant Formation. This illustrates the high influx of calcisiltites during the deposition of the Point Pleasant Formation. However, transitioning into the Utica shale at 6,390 ft (1,947.7 m), the Ti/Al packages reduce drastically and become constant, indicating that the Utica shale was deposited deeper into the basin. Generally, the Utica shale does not show drastic changes in Si/Al, Ti/Al and Zr/Nb, illustrating that this formation may not have had significant detrital input during the time of its deposition. Based on this observation, it appears that the Utica-Point Pleasant interval in both cores were deposited in different water depths resulting in different amounts of terrigenous input. The Point Pleasant Formation is characterized by slightly higher Si/Al and Zr/Nb as compared to the Utica shale which we will use to distinguish the boundary between the two formations in both cores.

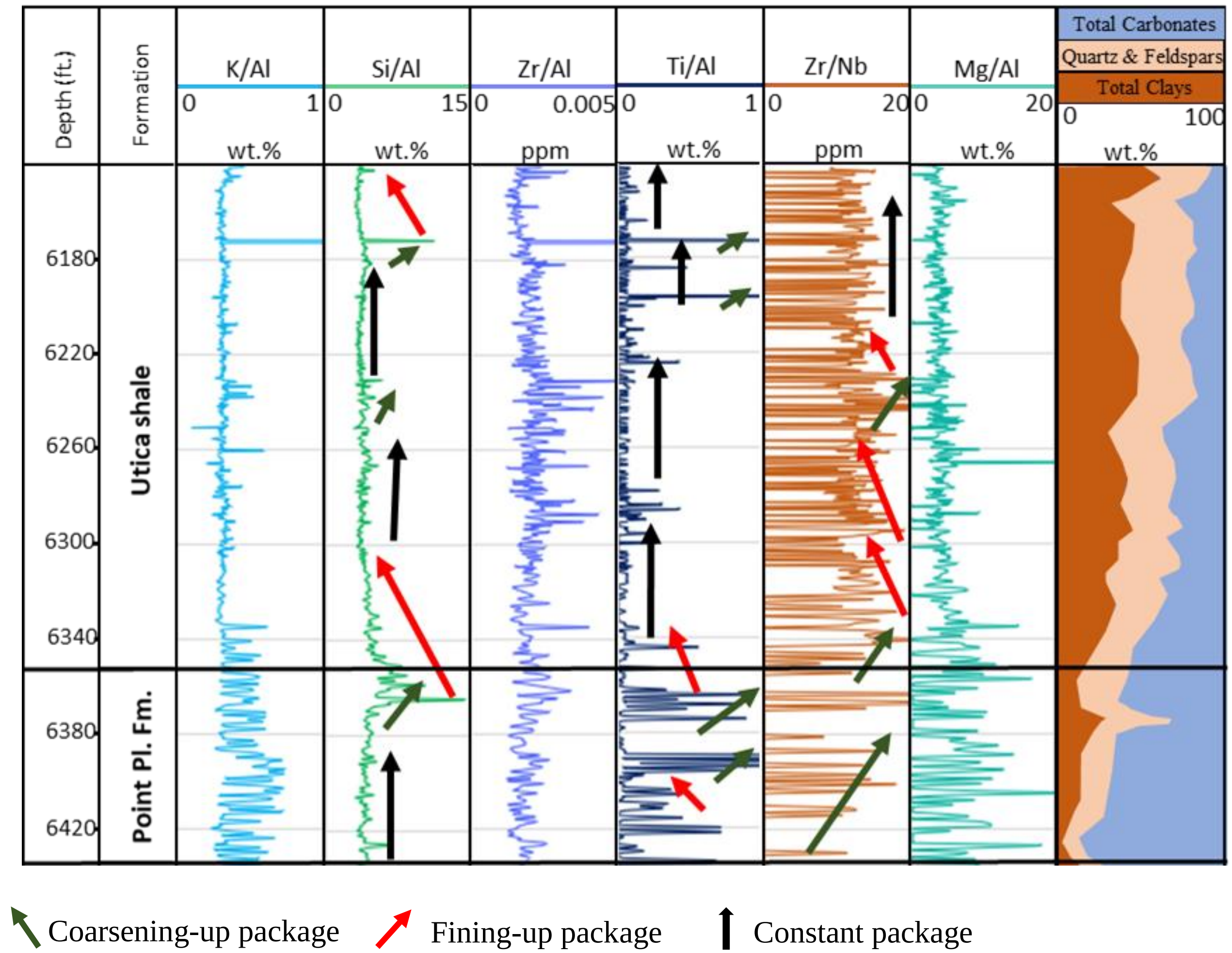


Figure 15. Stratigraphic plots of various detrital influx proxies in the Tracker core, Portage Co. (OH).

Paleoredox Conditions and Organic Matter Preservation from Trace Metals

Trace elements are used as paleoproductivity and paleoredox proxies in understanding paleoenvironmental conditions. Identifying paloeredox conditions using redox trace metals involves determining whether conditions at the time of deposition were oxidizing or reducing (Tribovillard et al., 2006). The solubility of redox-sensitive trace metals in oxic environments results in trace metal depletion while enrichment in oxygen deficient environments is as a result of their insolubility. Thus, paleoreox conditions may be described as oxic, suboxic, anoxic and euxinic depending on the amount of dissolved oxygen in the water column. Anoxic conditions can be nonsulfidic and sulfidic; sulfidic conditions are termed as euxinic when hydrogen sulfide occurs within the water column (Tribovillard et al., 2006). Suboxic conditions are identified by extremely low oxygen levels in the water column and hydrogen sulfide (H_2S) is limited to pore waters below the sediment-water interface (Tribobillard et al., 2006). Oxic environments create favorable conditions which aerobic organisms utilize for their metabolism resulting in organic matter degradation (Tribovillard et al., 2006). Molybdenum, V, U are used as proxies for the reconstruction of bottom-water conditions present during deposition. These redox trace elements separate reducing environments into suboxic and anoxic; Vanadium and U are mainly present in suboxic to anoxic environments whereas Mo is more confined in euxinic conditions. Paleoproductivity proxies such as Cu, Ni and Zn are associated with organic matter and act as micronutrients in the water column by solubility or adsorption (Tribovillard et al., 2006).

Redox conditions were not interpreted in detail for the Farley core due to the general depletion of redox trace elements. The discussion rather, inferred paleoredox conditions from the paleoproductivity proxies present. In the Tracker core, enrichment factors (EF's) were used to interpret bottom-water conditions and productivity. It is interesting to observe how trace elements are highly depleted throughout the Farley core but enriched throughout the Utica-Point Pleasant interval in the Tracker core. The general absence of an observed relationship between redox sensitive trace metals and productivity proxies with TOC (Figures 16 & 17) has several explanations but only two are discussed in this study.

Oxic conditions can result in the low concentrations of these elements in the basin. This can be interpreted as an indication of shallow water depths where wind and waves oxygenate the water column and prevent density stratification (Hemenway, 2018). Another explanation could be the limited supply of trace elements from global sea waters as a result of restricted conditions. According to Tribovillard et al. (2006), these elements are mostly present in sea water. Furthermore, anoxia in modern semi-restricted basins results in the concentration of these trace elements in sediments through sulfide precipitation (Hemenway, 2018). The Ordovician Oceanic Anoxic Event (OAE) which led to global marine anoxia, could be responsible for the low supply of trace elements to the water column. Thus, the redox proxies in the basin record local bottom water conditions during rather than global sea water conditions during deposition. This could explain the depleted trace metal values despite the bottom water conditions present.

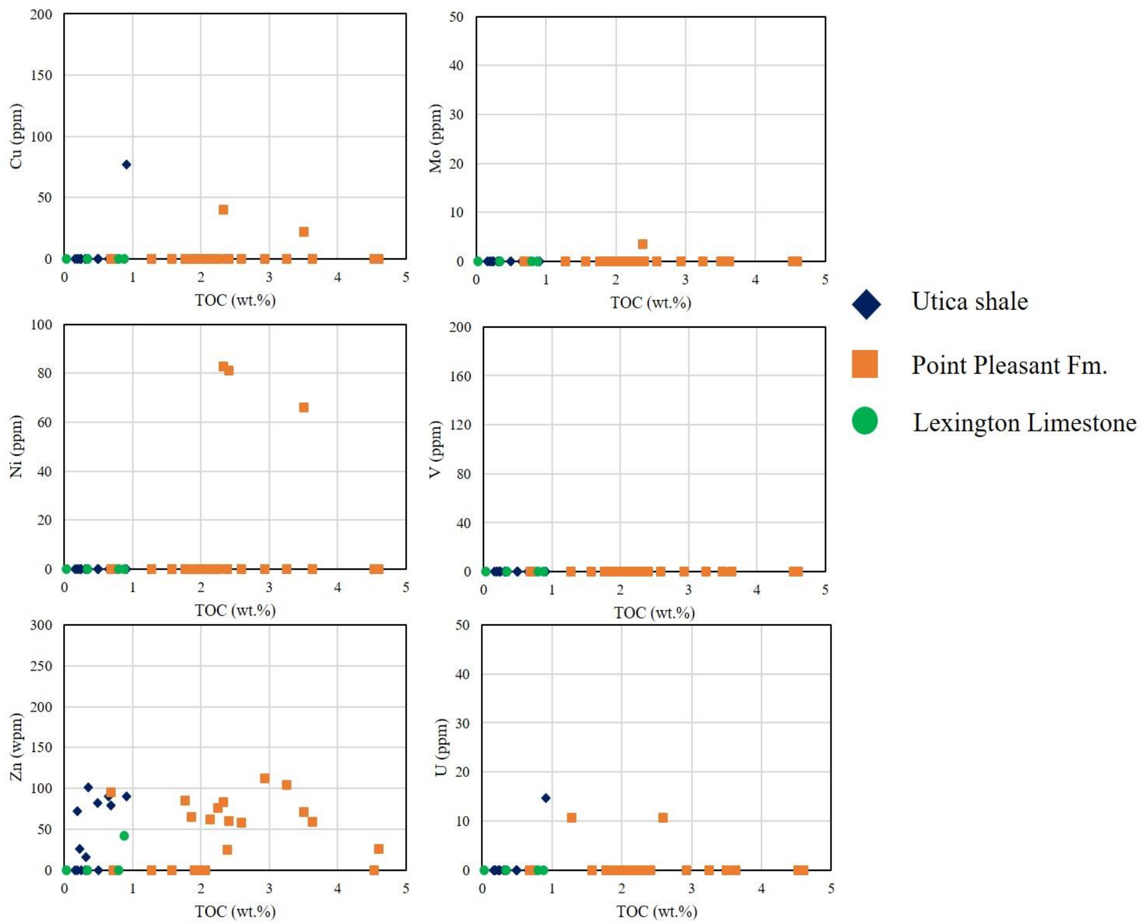


Figure 16. Cross-plots of paleoredox and paleoproductivity proxies with TOC in the Farley core, Washington Co. (OH).

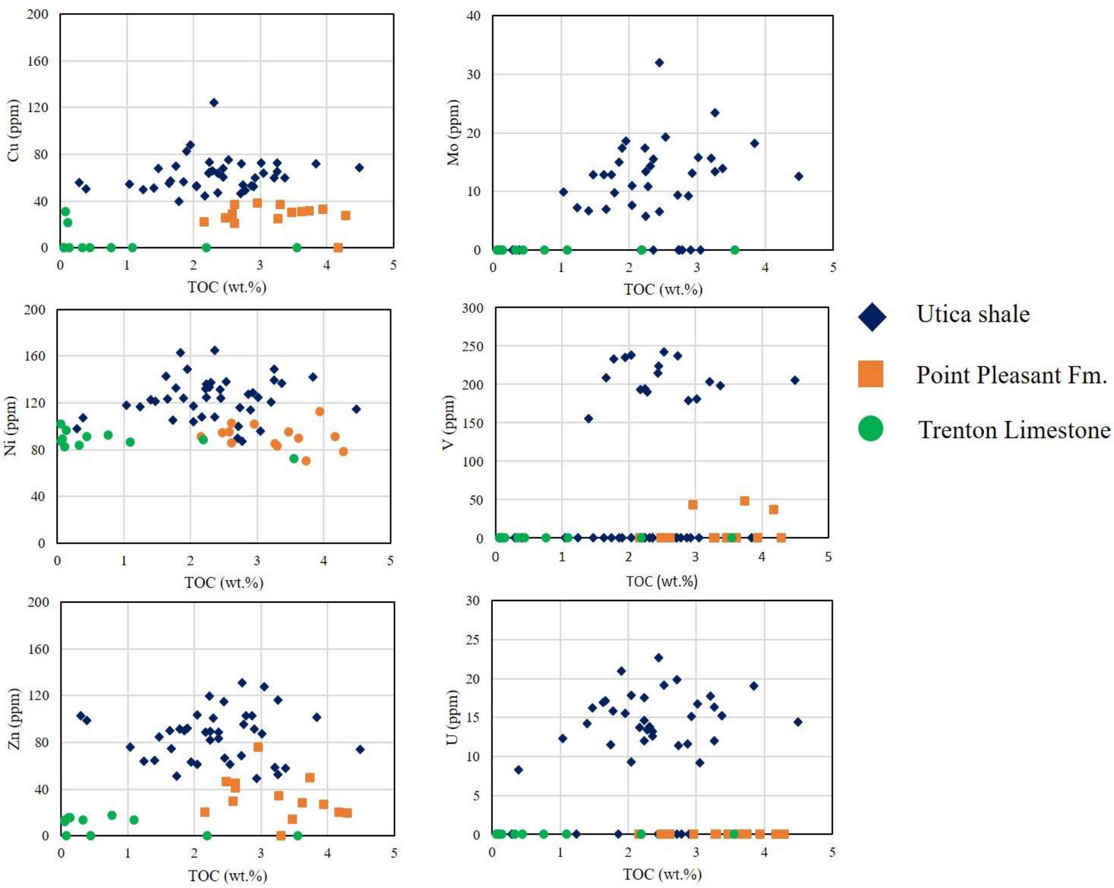


Figure 17. Cross-plots of paleoredox and paleoproductivity proxies with TOC in the Tracker core, Portage Co. (OH).

Based on those explanations, it is suspected that the two cores may have been deposited under different paleoredox conditions. Although there is a lack of an observed relationship between TOC and the paleoredox proxies, the enrichment of Mo, U and V suggest that the Utica-Point Pleasant interval in the Tracker core was deposited under anoxic to euxinic conditions and contain moderate to high amounts of organic matter (Figure 18). Conversely, the Utica shale in the Farley core is interpreted to have been deposited in an oxygen rich water column with low amounts of organic matter (Figure 19). This is further explained by the abundant storm beds that are present in the Utica shale resulting in the dilution of organic matter. The enrichment of TOC without Ni and Cu enrichment could be explained by the inability of Ni and Cu to be scavenged by settling organic particles.

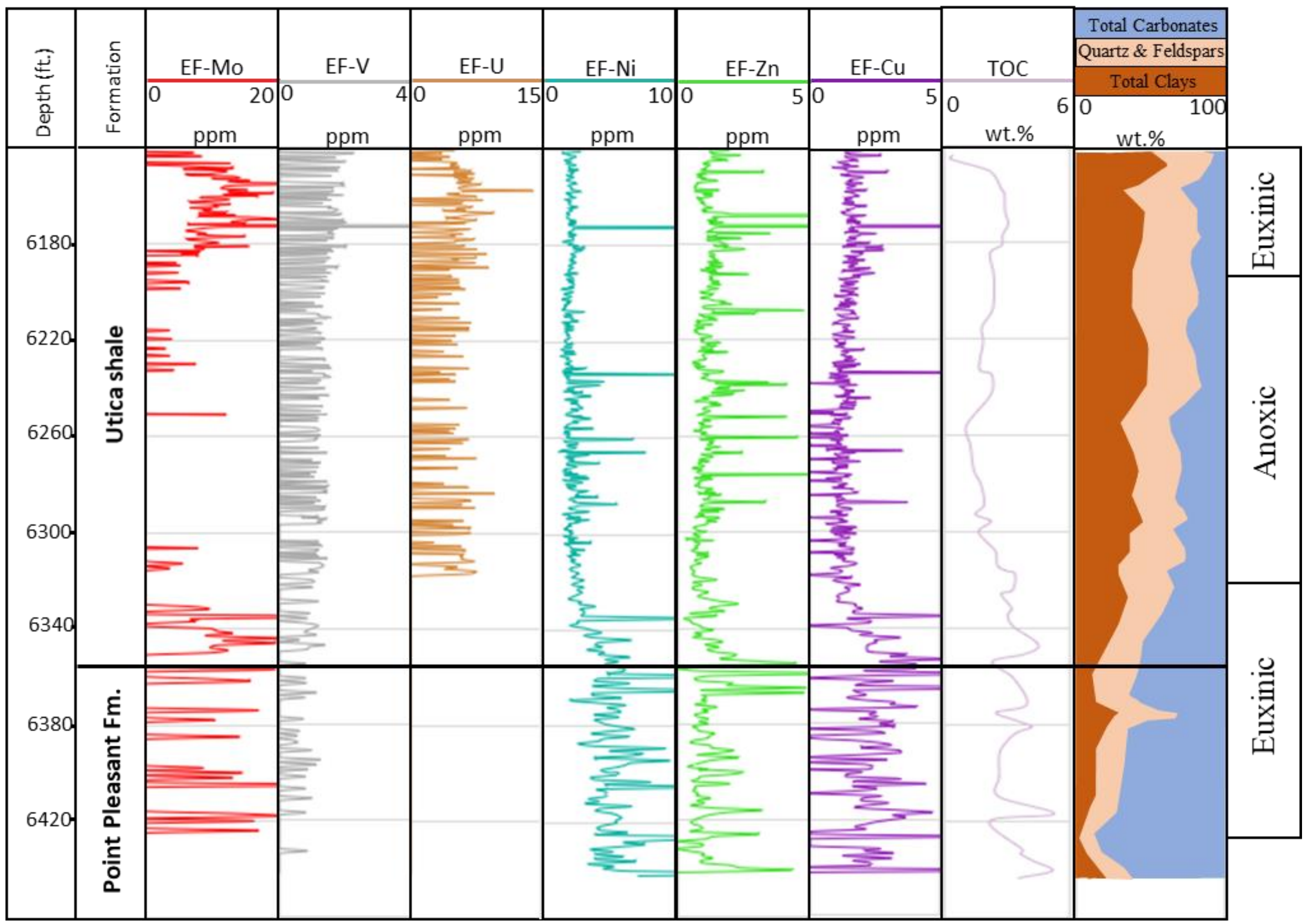


Figure 18. Stratigraphic plots of paleoredox and paleoproductivity proxies in the Tracker core, Washington Co. (OH).

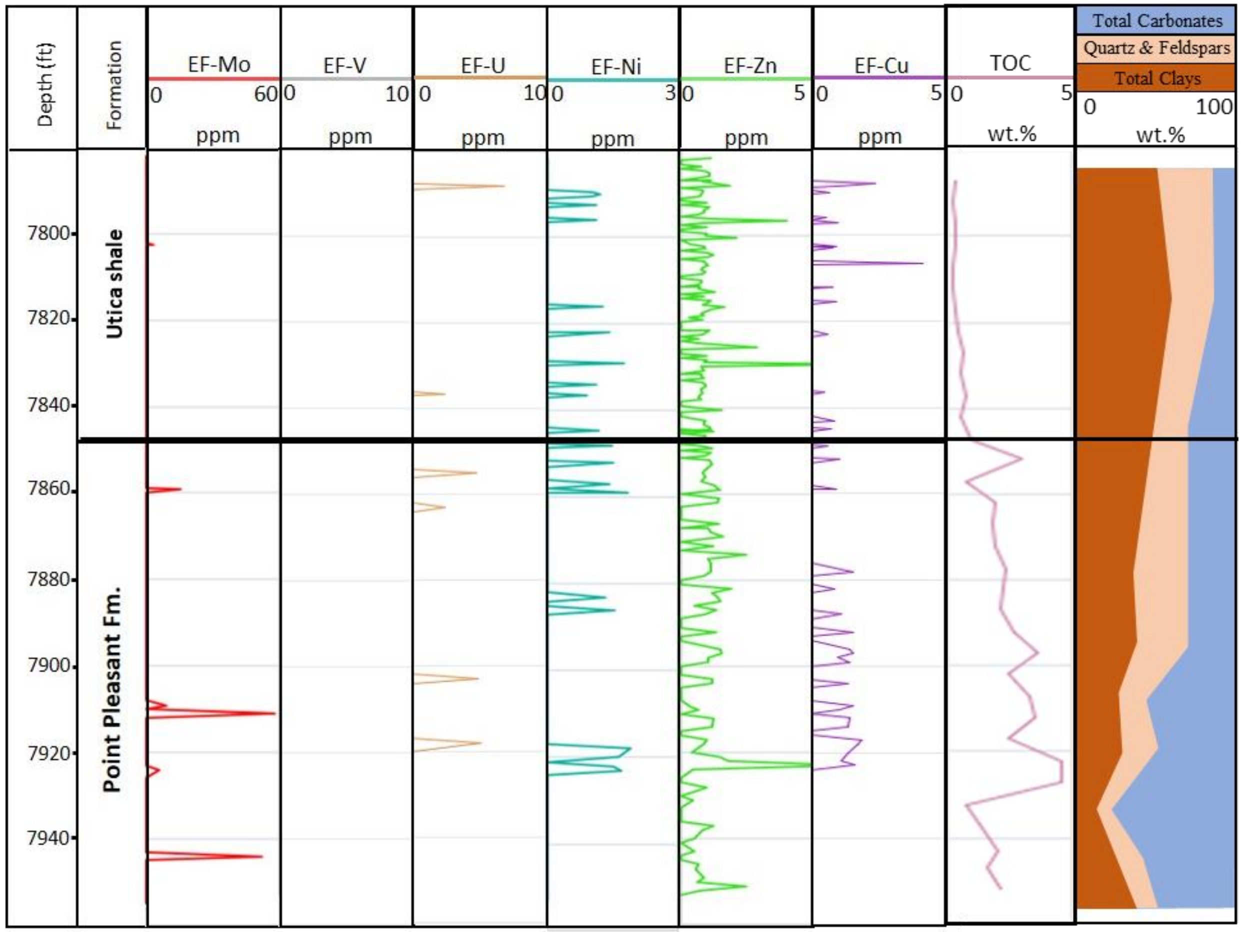


Figure 19. Stratigraphic plots of paleoredox and paleoproducitvity proxies in the Farley core, Washington Co. (OH).

Integrating all the data from both cores, it was determined that the Trenton/Lexington-Utica interval represents a transgressive sequence. The environment for the Farley core was mostly likely a carbonate shelf to a storm-dominated deep ramp between fair weather & storm base, <131 ft (40 m) (Pope and Read, 1997). The high clay content in the Utica-Point Pleasant interval represents increased terrigenous influx and a deeper portion of the carbonate ramp, while the higher carbonate content in the Lexington represents a shallow carbonate shelf. However, the shell hash and frequent storm bedding throughout suggests an environment above storm wave base and regular invasion by storm events (Figure 20). The presence of some other fossils that are known to be benthic like graptolites within the Utica shale, in addition to the abundance of storm beds, suggests that the bottom may not have been anoxic, or at least may have endured frequent intervals of being oxygenated. This is further confirmed with the general depletion of trace elements. The environment for the Tracker core is interpreted to be deep ramp, dominantly below storm wave base in anoxic bottom water, >131 ft (40 m) (Pope and Read 1997). The thick interval of Utica shale, high clay content, and anoxia suggest that the Utica shale and Point Pleasant Formation were deposited within the Sebree Trough. The underlying carbonate layers still represent the shallow carbonate Trenton platform which suggest water that was at times shallow, exposed to sunlight and well oxygenated. Combined with recent studies that have shown thickening of the shale and thinning of the underlying carbonate platform within the area, it is suggested that the Sebree Trough extends throughout northeastern Ohio (Bloxson, 2017; Bridges, 2020).

The Sebree Trough is a bathymetric linear depression which allowed cool, anoxic, phosphate-rich waters from the Iapetus Ocean (Kolata et al., 2001) to pass through and graptolitic shales to be deposited. The Tracker core is deposited in what is believed to be a potential extension of the Sebree Trough based on the thicker Utica shale sequence and deposition in euxinic to anoxic conditions. Bottom-water conditions are similar to that present in the Sebree Trough in Kentucky. Chemostratigraphy further supports the deposition of both cores in different bottom water-conditions by the enrichment of redox sensitive trace metals indicating euxinic to anoxic bottom water conditions in the Tracker core. In the Farley core, deposition is most likely outside of the trough based on the absence of trace metals due to oxygenated bottom-water conditions and a thinner Utica shale sequence.

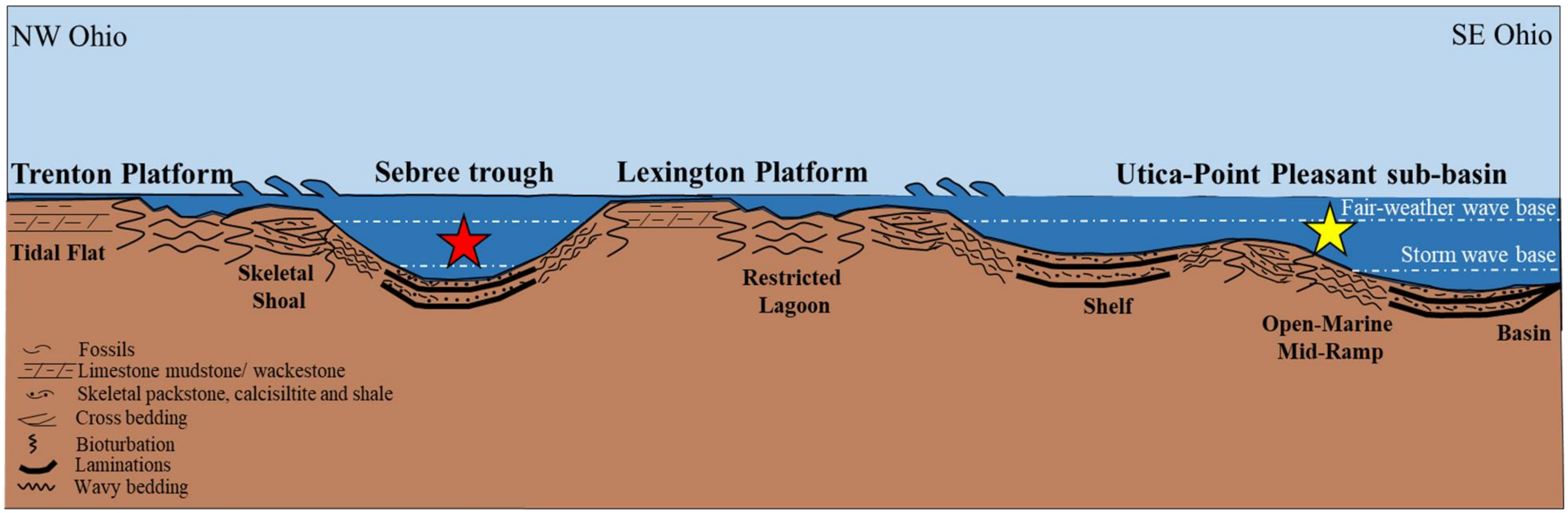


Figure 20. Depositional environment for the Utica shale Play, modified from Pope and Read (1997). Red and yellow stars represent the Tracker and Farley core respectively.

CONCLUSIONS

The Utica-Point Pleasant interval displays a significant geochemical variability using the Farley and Tracker cores located in the eastern part of the state. This study reveals the different conditions present during deposition as demonstrated with these cores. The following conclusions are based on the main results from this study:

1) Chemostratigraphy is a useful method of distinguishing between the formations in the Utica shale Play in Ohio.
2) Raw elemental curves allow identification of changes in mineralogy at a finer scale while cluster analysis removes the burden of meaningful pattern identification and correlations across the raw curves by grouping samples based on the degree of similarity to one another.
3) Decreased Ca concentration and increased Al from the Utica-Point Pleasant interval record a shift from the calcareous mudstones of the Point Pleasant to the siliciclastic-rich mudstones of the Utica shale.
4) It is assumed that the depositional environment for the Lexington-Utica interval in the Farley core was mostly likely a carbonate shelf to a storm-dominated deep ramp between fair weather and storm base, <131 ft (40 m), frequently disturbed by storm currents. The Trenton-Utica interval in the Tracker core was interpreted to be deep ramp, dominantly below storm wave base in anoxic bottom water, >131 ft (40 m).

These different conditions support the existence of separate depocenters across the area.

5) Bottom conditions of the Tracker Core compared to the Farley core suggests an extension of the Sebree Trough across northeast Ohio, where oceanic conditions allowed for the enrichment of redox sensitive trace metals indicating euxinia to anoxia

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APPENDICES

Appendix A. XRD results for the Farley core, Washington Co. (OH). Modified from Core Laboratories (2013).

	Whole Rock Mineralogy (wt.%)							
Depth (ft)	Formation	Quartz	Plagioclase	K-Feldspar	Calcite	Dolomite & Fe-Dolomite	Pyrite	Total Clay
7786.10	Utica	27.1	5.4	0.3	14.8	2.7	3.1	46.6
7816.35		21.6	6.4	0.5	12.2	2.2	3.6	53.6
7846.40		20.4	3.8	0.9	27.8	3.1	2.2	41.9
7876.60	PP	26.6	3.7	0.6	31.4	0.0	3.1	34.7
7894.60		25.1	5.6	0.4	28.6	0.8	3.6	36.0
7906.40		14.4	3.1	0.9	49.9	1.7	5.1	24.9
7918.40		17.8	3.1	0.3	44.9	1.3	5.0	27.3
7931.45		8.1	1.2	0.0	69.4	4.8	1.5	15.0
7941.95		10.7	2.5	0.7	57.6	0.9	3.7	24.0
7953.80		9.5	2.4	0.8	47.8	0.7	4.0	34.9
7965.10	Lexington	1.4	0.0	0.0	95.4	0.0	1.0	2.1
7978.40		20.9	1.3	0.0	65.5	1.1	1.6	9.6

Appendix B. XRD results for the Tracker core, Portage Co. (OH).

Modified from TerraTek (2014)

		Whole Rock Mineralogy (wt.%)										
Depth (ft)	Formation	Quartz	Plagioclase	K-Feldspar	Calcite	Siderite	Ankerite	Dolomite	Pyrite	Fluorapatite	Barite	Total Clay
6142.35	Utica	23	5	8	4	1	3	0	3	0	0	53
6148.24		25	0	0	5	0	0	10	3	0	0	58
6156.25		20	3	6	11	1	3	15	5	0	0	36
6165.65		22	4	5	12	0	5	3	5	0	0	45
6175.23		27	6	1	12	0	3	2	5	1	0	43
6182.75		26	4	1	18	0	5	1	4	0	2	39
6202.86		24	3	6	15	0	2	5	4	0	0	41
6213.67		21	5	4	17	0	5	4	3	1	0	42
6230.71		23	2	1	17	0	3	1	3	0	1	48
6239.21		24	6	0	13	0	4	3	2	0	1	47
6254.41		23	6	2	28	1	7	1	3	0	0	29
6272.46		22	5	1	23	0	3	5	2	1	0	38
6286.92		21	4	4	24	1	4	4	2	0	0	36
6293.72		18	0	13	21	0	0	5	2	0	1	41
6301.75		21	2	4	23	0	4	7	3	1	1	35
6312.15		26	6	2	18	0	4	5	4	0	0	36
6315.56		20	7	2	28	0	4	9	3	1	0	27
6323.89		24	2	1	29	0	0	7	3	0	0	35
6332.66		22	1	0	34	0	3	6	4	0	0	31
6344.87		21	0	1	47	0	0	6	3	0	0	23
6351.92		17	0	1	52	0	0	3	6	1	0	19
6369.65	PP	15	0	0	63	0	2	3	2	1	1	14
6375.83		11	0	3	58	0	0	4	2	0	0	23
6381.15		12	0	6	59	0	3	4	3	0	0	14
6390.16		10	0	0	66	0	2	2	2	0	0	17
6407.76		10	0	0	69	0	0	6	1	1	0	13
6417.87		5	0	0	80	0	0	5	2	3	0	4
6431.37		12	0	1	64	0	0	5	3	2	0	13
6438.44		13	1	7	54	0	0	3	3	2	0	17
6442.77		15	0	0	66	0	0	7	1	2	0	9
6450.90	Trenton	2	0	0	92	0	1	4	0	0	0	0
6457.36		7	0	0	83	0	4	5	0	2	0	0

Appendix C. TOC data for the Farley core, Washington Co. (OH).

Modified from Core Laboratories (2013).

Depth (ft)	Formation	TOC (wt.%)
7787.2	Utica	0.23
7792.1		0.19
7798.0		0.31
7802.1		0.25
7807.1		0.19
7812.0		0.16
7817.4		0.32
7822.0		0.32
7827.0		0.65
7832.0		0.5
7837.0		0.68
7842.0		0.49
7847.3		0.91
7852.0	PP	2.93
7857.0		0.72
7862.0		1.86
7867.0		1.77
7872.0		1.9
7877.6		2.33
7882.0		2.25
7887.0		2.13
7892.0		2.59
7897.0		3.63
7907.4		3.25
7912.0		3.5
7917.0		2.39
7922.0		4.53
7927.0		4.6
7932.5		0.68
7937.0		1.28
7943.0		2.02
7947.0		1.57
7952.0		2.06
7957.0	Lexington	0.8
7962.0		0.88
7967.0		0.34
7972.0		0.03

Appendix D. TOC data for the Tracker core, Portage Co. (OH).

Modified from TerraTek (2014).

Depth (ft)	Formation	TOC (wt.%)
6144	Utica	0.39
6145.4		0.29
6149.8		2.04
6152.9		2.44
6157.9		2.72
6159.9		2.87
6167.3		2.90
6172.3		3.05
6176.8		2.78
6181.1		2.74
6184.4		2.17
6193.4		2.36
6204.5		2.36
6209.0		2.24
6215.3		1.78
6221.3		1.85
6232.3		1.66
6234.4		2.24
6240.8		2.31
6245.2		2.04
6256.0		1.04
6263.8		1.24
6274.1		1.40
6280.0		1.74
6288.5		1.90
6292.5		1.47
6295.3		2.23
6299.3		1.63
6303.4		1.95
6308.0		2.45
6313.8		2.53
6315.9		2.93
6317.2		3.37
6324.0		3.26
6325.5		2.71
6331.4		3.21
6334.3		3.02
6338.8		3.26
6346.5		4.49
6350.4		3.84
6353.5		2.28

Continued

6360.4	PP	3.30
6371.3		3.94
6374.5		2.48
6377.4		3.27
6380.4		4.17
6382.8		3.47
6386.7		2.96
6391.8		2.62
6401.1		2.62
6409.4		2.58
6416.5		5.25
6419.5		2.16
6431.4		3.74
6433.0		3.62
6436.2		4.29
6440.0		5.17
6443.1		3.55
6444.4	Trenton	2.19
6446.9		1.09
6452.5		0.11
6457.2		0.76
6459.0		0.44
6463.9		0.08
6466.8		0.33
6468.1		0.06
6469.5		0.06
6471.3		0.14

Appendix E. XRF results of major (wt.%) and trace elements (ppm) for the Tracker core, Portage Co. (OH).

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6141.0	4.90	16.74	2.22	0.00	4.97	1.78	0.00	1.99	0.01	0.08	0.00	0.00	8.30	107.14	50.20	98.64	8.02	59.96	118.15	33.51	1
6141.6	7.98	28.22	2.83	0.00	5.32	2.39	1.30	0.95	0.01	0.06	0.00	0.00	0.00	97.59	56.13	102.44	23.59	62.07	129.97	31.48	1
6142.0	7.40	28.79	2.69	0.57	5.02	2.65	1.12	2.26	0.02	0.00	7.59	238.16	9.26	104.05	52.68	103.54	7.81	57.00	145.77	37.01	2
6142.6	8.30	29.34	2.70	0.57	5.58	3.03	1.72	1.29	0.01	0.05	6.54	214.31	0.00	131.47	68.08	114.91	6.64	56.94	145.99	43.14	2
6143.0	5.15	26.24	1.70	0.00	4.71	1.89	0.90	2.31	0.03	0.00	0.00	0.00	0.00	99.98	71.86	130.66	9.15	84.75	169.27	20.24	1
6143.6	7.49	28.59	2.69	0.00	5.08	2.21	1.38	1.31	0.01	0.06	9.18	0.00	11.56	127.41	53.22	102.76	0.00	58.57	118.87	48.86	2
6144.0	7.02	24.33	2.39	0.49	4.17	1.82	1.20	8.40	0.03	0.06	0.00	178.56	0.00	114.07	52.50	91.68	10.27	48.10	114.56	16.14	1
6144.6	7.53	27.31	2.68	0.00	4.87	2.46	1.24	1.16	0.01	0.06	0.00	0.00	9.21	95.81	64.16	127.66	10.81	61.84	127.37	12.62	1
6145.0	5.28	18.06	2.30	0.00	4.66	1.97	0.00	2.16	0.02	0.08	0.00	0.00	0.00	87.37	48.82	102.49	9.42	149.47	144.47	23.76	1
6145.6	8.24	28.22	2.99	0.64	5.05	2.29	1.19	1.74	0.02	0.07	0.00	236.91	11.45	115.68	53.60	95.62	9.46	61.87	147.31	23.03	2
6146.0	7.73	25.19	2.72	0.56	5.12	2.89	1.39	1.37	0.02	0.10	0.00	192.93	13.68	108.12	44.44	88.61	9.31	63.19	142.91	33.82	2
6146.6	8.45	28.87	2.72	0.00	5.77	3.75	1.35	1.25	0.01	0.11	15.58	0.00	13.24	164.67	63.76	83.45	13.70	57.87	125.50	80.23	2
6147.0	7.04	23.98	2.68	0.00	5.27	2.66	0.62	1.57	0.01	0.12	0.00	0.00	12.62	108.07	47.00	88.70	11.31	62.96	119.85	27.20	1
6147.6	7.81	30.56	2.46	0.00	4.93	2.67	1.37	1.21	0.02	0.12	5.70	0.00	12.05	125.00	73.12	89.46	23.68	54.44	134.70	36.75	1
6148.0	8.62	29.00	2.77	0.56	5.09	2.18	1.70	2.59	0.01	0.11	9.71	233.59	15.85	132.40	39.52	91.16	9.49	56.54	142.92	41.78	2
6148.6	7.82	27.61	2.64	0.00	5.80	3.88	1.03	1.27	0.01	0.11	14.92	0.00	0.00	162.65	56.26	90.23	7.86	132.74	153.42	68.08	2

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6149.0	8.20	27.86	2.70	0.56	5.15	2.39	1.38	2.65	0.02	0.05	6.91	208.75	17.10	123.25	57.09	74.89	8.18	51.04	131.22	50.46	2
6149.6	7.55	26.76	2.28	0.46	4.88	2.42	1.44	5.72	0.02	0.11	13.34	194.60	17.54	136.25	64.71	81.77	7.78	49.67	124.85	53.67	2
6150.0	8.09	27.35	2.42	0.97	5.24	3.12	1.54	3.34	0.02	0.27	14.34	0.00	13.81	137.35	124.48	275.49	9.66	54.37	117.30	73.14	2
6150.6	7.19	23.67	2.17	0.00	4.66	2.27	2.21	9.50	0.02	0.19	11.01	0.00	17.80	117.19	52.82	61.47	7.19	43.86	95.11	45.00	2
6151.0	7.21	23.62	2.17	0.00	4.78	2.12	2.17	9.11	0.03	0.15	9.90	0.00	12.30	117.96	54.26	75.89	7.93	103.73	112.01	35.01	2
6151.6	6.72	23.39	2.04	0.36	4.62	1.98	1.62	9.74	0.03	0.14	6.62	155.25	14.22	122.61	50.99	64.57	9.11	42.07	110.38	46.17	2
6152.0	6.70	22.54	2.03	0.94	4.88	2.32	1.57	8.66	0.03	0.17	12.88	0.00	11.47	105.21	69.82	51.32	10.78	103.12	111.34	52.63	2
6152.6	8.60	30.32	2.76	0.00	4.84	2.90	1.23	2.10	0.01	0.13	17.41	0.00	21.00	124.33	82.59	91.97	10.37	55.38	122.78	54.46	2
6153.0	8.64	28.95	2.71	0.00	4.61	2.62	1.62	4.06	0.02	0.10	12.86	0.00	16.24	121.52	68.16	84.92	10.91	54.05	107.11	47.25	2
6153.6	7.66	26.71	2.40	0.00	4.42	2.20	1.25	6.48	0.03	0.17	17.38	0.00	14.60	131.85	63.89	119.67	9.90	120.88	127.64	34.67	2
6154.0	7.15	23.73	2.14	0.00	4.71	2.37	1.91	8.40	0.02	0.21	12.90	0.00	16.94	142.48	54.93	90.29	14.10	44.60	105.43	49.79	2
6154.6	8.46	29.55	2.57	0.53	5.04	3.10	1.33	2.97	0.02	0.15	18.56	235.44	15.51	149.07	88.13	63.05	9.50	53.79	140.57	79.35	2
6155.0	8.34	29.18	2.58	0.52	4.66	2.72	1.11	4.31	0.02	0.04	32.07	223.46	22.64	124.10	60.58	66.38	10.02	55.07	141.21	64.25	2
6155.6	8.49	28.92	2.58	0.51	4.91	2.99	1.75	4.37	0.02	0.13	19.32	241.91	19.18	138.16	75.05	60.93	7.80	53.07	136.44	70.85	2
6156.0	7.36	23.24	2.10	0.00	4.96	2.33	2.75	9.88	0.03	0.15	13.04	0.00	15.08	128.70	59.83	49.05	6.09	101.54	123.95	53.45	2

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6156.6	8.30	27.02	2.49	0.46	4.65	2.68	2.22	6.07	0.02	0.16	13.97	197.90	15.22	136.78	59.70	57.77	8.94	51.11	131.29	54.85	2
6157.0	8.05	26.53	2.39	0.00	4.79	2.82	1.68	6.23	0.02	0.14	13.33	0.00	16.34	148.70	65.12	52.83	19.67	50.41	106.64	73.13	2
6157.6	4.18	13.26	1.27	0.00	3.38	1.21	1.24	20.70	0.03	0.00	9.29	0.00	19.85	89.88	46.37	68.27	9.91	40.56	96.52	34.82	1
6158.0	8.67	27.29	2.52	0.46	4.76	3.03	2.43	6.82	0.02	0.17	15.70	203.57	17.75	120.82	60.11	58.84	11.18	47.94	128.29	65.18	2
6158.6	8.61	27.21	2.46	0.43	4.57	3.06	2.02	7.14	0.03	0.17	15.83	181.40	16.70	124.36	72.40	87.04	6.41	46.55	125.53	58.00	2
6159.0	8.42	28.24	2.67	0.00	5.04	3.90	1.14	3.28	0.02	0.12	23.40	0.00	12.04	139.74	72.46	115.87	9.96	133.80	126.68	65.40	2
6159.6	7.27	24.81	2.46	0.44	4.58	2.58	1.16	6.74	0.03	0.13	12.53	205.79	14.42	114.89	68.79	73.86	8.10	50.22	126.79	58.00	2
6160.0	7.50	26.57	2.49	0.00	4.45	4.75	1.59	5.15	0.02	0.10	18.21	0.00	19.02	142.17	72.12	101.58	9.45	53.11	106.38	57.14	2
6160.6	8.97	28.69	2.39	0.45	4.66	3.21	1.58	6.03	0.03	0.06	10.79	190.38	13.38	133.53	65.58	100.84	10.04	47.92	132.53	57.45	2
6161.0	8.32	27.17	2.50	0.00	4.29	2.84	1.89	6.43	0.03	0.10	10.04	0.00	0.00	122.67	58.80	68.02	7.00	114.51	130.27	44.73	2
6161.6	6.79	23.74	2.21	0.39	4.02	2.47	1.07	10.39	0.04	0.12	12.27	155.28	19.12	111.10	47.49	61.54	8.09	42.81	117.45	42.28	2
6162.0	6.69	22.55	1.97	0.00	4.35	2.36	1.71	12.34	0.04	0.07	10.49	0.00	0.00	105.08	46.11	57.92	9.96	93.10	118.11	36.25	2
6162.6	7.64	26.27	2.37	0.00	4.52	2.55	1.72	6.90	0.02	0.12	7.42	0.00	15.09	116.32	66.62	81.65	29.02	49.57	103.10	41.25	1
6163.0	7.81	26.38	2.34	0.42	4.30	2.49	1.78	7.34	0.03	0.14	8.17	151.81	13.63	124.24	51.35	72.96	6.88	47.94	125.06	43.44	2
6163.6	7.32	25.79	2.19	0.00	4.18	2.72	1.47	9.31	0.04	0.14	13.30	0.00	0.00	121.64	57.29	68.38	10.31	101.48	113.44	41.00	2

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6164.0	6.32	23.71	2.05	1.23	4.19	2.48	1.00	8.62	0.03	0.00	9.40	0.00	12.90	127.48	70.37	68.28	10.24	43.83	99.34	43.09	1
6164.6	8.12	29.32	2.36	0.46	4.19	2.80	1.30	6.02	0.03	0.13	12.69	184.18	19.32	123.56	71.51	96.02	6.57	48.00	126.28	43.97	2
6165.0	7.52	26.30	2.26	0.40	4.38	2.99	1.69	8.27	0.03	0.06	7.45	165.88	13.70	127.56	66.64	99.19	10.90	44.77	116.81	51.26	2
6165.6	6.78	24.66	2.26	0.41	4.06	2.12	1.17	9.04	0.03	0.09	9.63	176.10	14.21	113.93	50.25	65.14	8.92	44.73	129.38	34.00	2
6166.0	7.10	25.25	2.27	0.43	4.38	2.57	1.46	7.11	0.03	0.11	8.81	180.87	8.99	109.91	54.68	82.26	12.30	48.96	127.60	35.45	2
6166.6	7.98	27.80	2.33	0.43	3.91	2.54	2.00	7.91	0.03	0.10	11.01	191.49	20.69	108.71	50.55	83.36	11.41	45.95	132.04	27.63	2
6167.0	7.35	26.48	2.07	0.00	4.10	2.65	1.29	9.36	0.03	0.20	13.14	0.00	23.58	117.69	48.11	133.23	9.46	44.11	123.00	31.77	2
6167.6	8.17	28.79	2.43	0.48	4.05	2.79	0.88	6.53	0.03	0.18	9.62	220.19	19.73	118.35	56.39	180.93	8.33	47.75	135.97	25.52	2
6168.0	7.80	27.69	2.27	0.46	4.06	2.52	0.90	6.72	0.03	0.17	15.39	199.87	16.55	114.62	84.28	1622.14	10.70	47.64	133.88	23.82	2
6168.6	8.54	29.47	2.59	0.00	4.13	2.22	1.53	5.28	0.02	0.14	10.05	0.00	14.97	125.00	70.03	121.85	12.06	52.19	112.48	30.39	1
6169.0	7.87	30.52	2.50	0.00	4.29	2.80	1.22	3.13	0.02	0.06	18.38	0.00	11.19	115.81	61.62	108.16	9.27	127.86	133.80	38.19	2
6169.9	7.09	26.37	2.26	0.40	4.54	3.38	1.30	6.77	0.03	0.19	20.74	173.83	17.99	138.22	64.59	113.55	7.72	45.17	126.84	44.78	2
6170.0	7.96	28.86	2.51	0.62	4.27	2.62	1.18	4.93	0.02	0.13	18.64	220.33	19.33	123.70	60.29	96.82	9.22	51.08	126.96	35.90	2
6170.6	6.90	25.85	2.01	0.00	4.18	2.79	1.56	8.24	0.03	0.13	13.40	0.00	14.40	131.54	67.59	101.39	23.67	43.38	110.95	36.14	1
6171.0	7.52	27.89	2.07	0.00	4.26	3.34	0.95	8.16	0.04	0.13	14.00	0.00	0.00	113.45	55.15	94.40	8.64	105.66	127.33	43.04	2

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6171.6	7.23	26.10	2.15	0.42	4.30	3.27	1.09	9.17	0.04	0.13	15.54	171.72	10.20	111.23	65.52	93.43	8.46	45.66	125.85	42.95	2
6172.0	5.61	22.51	1.97	0.00	3.74	2.54	0.93	10.74	0.04	0.07	5.87	0.00	0.00	111.39	56.31	81.91	8.96	97.69	123.43	28.56	2
6172.6	0.21	2.32	2.13	0.36	4.07	0.29	0.00	9.08	0.04	0.00	13.83	143.37	0.00	114.06	64.24	124.46	25.07	43.64	128.38	37.74	2
6173.0	6.67	25.93	1.99	0.00	4.25	2.79	1.01	8.12	0.04	0.00	11.68	0.00	0.00	119.41	56.05	111.19	7.76	104.63	128.50	43.35	2
6173.6	6.33	24.37	2.03	0.39	3.81	1.96	1.20	9.31	0.04	0.09	7.93	164.84	14.27	109.77	56.85	87.89	7.23	41.95	129.50	28.02	2
6174.0	6.52	25.70	2.05	0.00	3.69	2.11	1.12	9.97	0.04	0.04	6.97	0.00	12.25	114.62	50.33	89.63	9.63	41.80	110.28	27.01	1
6174.6	6.93	28.16	2.11	0.43	3.81	2.44	1.57	7.47	0.03	0.08	6.15	162.65	8.73	101.76	66.50	85.27	9.50	44.41	129.12	30.26	2
6175.0	6.76	27.11	2.12	0.43	3.78	2.24	1.14	8.58	0.04	0.11	6.95	147.63	0.00	113.32	48.41	79.76	9.73	42.85	131.71	32.98	2
6175.6	6.05	26.27	1.99	0.37	4.12	2.36	1.11	7.26	0.04	0.11	7.89	134.75	11.80	116.62	78.18	221.94	6.56	42.32	119.53	35.01	2
6176.0	6.79	27.48	2.19	0.53	3.75	2.31	1.34	7.47	0.03	0.15	7.91	161.46	10.42	101.53	66.08	105.41	7.77	44.31	129.55	24.63	2
6176.6	6.61	27.12	2.09	0.00	3.79	2.33	1.43	7.24	0.03	0.12	9.95	0.00	11.04	119.39	63.75	98.29	10.36	45.20	108.14	28.25	1
6177.0	7.26	28.52	2.13	0.44	4.43	3.28	1.27	7.31	0.03	0.11	15.66	149.43	0.00	122.83	55.89	89.11	9.16	45.09	128.28	39.96	2
6177.6	6.36	25.78	1.92	0.38	3.47	1.99	0.95	9.98	0.05	0.14	8.05	150.76	13.35	113.72	59.12	159.48	10.01	40.11	128.31	23.80	2
6178.0	7.64	29.22	2.30	0.00	3.47	1.80	1.72	7.21	0.03	0.11	7.00	0.00	18.83	104.43	61.21	113.28	20.38	46.23	110.05	22.11	1
6178.6	7.94	30.78	2.38	0.46	3.58	2.33	1.88	5.82	0.03	0.10	8.38	169.32	13.76	95.59	57.66	94.54	8.15	45.62	126.60	26.08	2
6179.0	6.63	28.36	2.17	0.00	4.20	2.97	0.82	6.27	0.03	0.06	9.07	0.00	11.46	113.02	56.83	113.51	8.99	44.23	116.26	39.39	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6179.6	7.07	29.83	2.08	0.00	3.75	2.59	1.23	7.07	0.04	0.08	11.29	0.00	0.00	110.82	81.85	121.92	7.48	104.60	153.95	28.87	2
6180.0	6.39	28.07	2.01	0.00	3.61	2.20	0.71	8.72	0.04	0.09	8.78	0.00	0.00	129.32	46.68	123.78	6.03	102.66	134.51	23.15	2
6180.6	6.73	26.51	1.97	0.39	3.36	2.01	1.33	10.43	0.05	0.13	7.88	138.50	13.75	118.08	59.10	119.63	7.93	40.03	137.26	22.56	2
6181.0	6.77	26.85	2.15	0.42	3.87	2.96	1.14	8.51	0.04	0.13	7.34	169.41	12.81	131.32	44.75	97.64	9.58	44.97	126.55	27.77	2
6181.6	5.61	24.69	1.84	0.00	3.39	2.08	0.43	11.56	0.04	0.00	6.24	0.00	0.00	101.36	60.89	103.84	24.40	38.35	101.52	22.12	4
6182.0	5.04	24.42	1.71	0.49	3.35	1.93	0.64	11.26	0.05	0.00	6.48	117.50	13.19	113.90	72.21	133.02	20.19	35.15	162.77	28.85	1
6182.6	5.72	25.46	2.01	0.00	4.03	2.48	0.84	8.78	0.04	0.02	6.87	0.00	0.00	112.49	81.74	129.21	7.47	103.39	128.31	30.65	2
6183.0	5.56	24.81	1.97	0.40	3.33	1.59	1.02	10.09	0.05	0.08	0.00	135.05	0.00	106.04	45.68	75.42	9.86	41.34	133.33	16.92	1
6183.6	5.74	24.91	1.98	0.00	3.25	1.69	0.52	10.75	0.05	0.10	6.61	0.00	0.00	92.89	59.68	68.79	7.38	96.46	131.33	17.75	2
6184.0	5.40	21.61	1.70	2.62	3.22	1.89	0.96	10.76	0.05	0.00	4.14	115.92	16.17	97.76	54.66	74.19	9.10	38.22	116.60	29.44	1
6184.6	5.83	23.21	1.83	0.00	3.86	2.49	1.26	12.26	0.05	0.04	6.60	0.00	0.00	109.96	58.48	84.93	9.81	92.13	122.69	27.20	2
6185.0	5.76	23.34	1.85	0.00	3.68	2.41	1.09	11.73	0.05	0.04	0.00	0.00	0.00	102.51	40.05	70.68	6.18	94.36	130.90	21.91	1
6185.6	5.72	24.14	1.93	0.39	3.59	1.92	1.21	11.14	0.05	0.03	0.00	126.97	14.15	89.78	51.48	82.74	9.63	39.11	141.63	19.40	1
6186.0	6.37	25.50	2.05	0.38	3.59	1.82	0.90	9.07	0.04	0.08	0.00	140.99	10.37	113.43	49.04	87.70	10.33	43.57	128.92	18.93	1
6186.6	6.03	24.94	1.88	0.00	3.36	1.79	0.82	11.94	0.05	0.00	0.00	0.00	11.07	96.08	64.57	91.66	9.95	36.42	114.82	19.88	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6189.0	6.79	25.70	2.14	0.43	4.05	2.88	1.60	9.34	0.04	0.06	5.16	116.58	0.00	118.26	58.53	84.11	8.00	43.24	125.47	30.19	2
6189.6	5.46	22.05	1.99	0.37	3.54	1.61	1.05	11.70	0.05	0.08	0.00	137.92	16.57	92.86	41.86	95.00	8.53	38.29	123.17	20.56	1
6190.0	7.25	26.47	2.27	0.00	3.64	1.92	1.73	8.76	0.05	0.07	0.00	0.00	0.00	109.20	85.33	80.73	6.99	108.62	123.00	17.90	1
6190.6	6.79	26.33	2.24	0.43	3.73	1.83	0.80	9.02	0.04	0.00	0.00	138.60	10.54	111.56	62.65	99.83	8.93	47.12	126.66	24.59	1
6191.0	7.24	28.05	2.23	0.45	3.82	2.16	1.57	7.78	0.04	0.00	0.00	146.31	0.00	106.72	51.01	103.49	10.38	44.62	133.00	21.70	1
6191.6	5.54	23.13	1.94	0.00	3.73	2.74	0.69	10.45	0.05	0.06	0.00	0.00	0.00	111.39	56.52	82.42	8.72	99.45	131.62	24.37	1
6192.0	7.05	27.60	2.18	0.42	3.78	2.54	0.64	9.04	0.04	0.09	5.16	160.25	0.00	93.51	89.18	86.01	8.27	43.78	135.42	25.18	2
6192.6	5.72	22.83	1.76	0.00	3.41	1.82	1.40	13.20	0.05	0.10	0.00	0.00	0.00	86.80	60.31	160.28	11.63	89.37	127.78	22.09	1
6193.0	6.32	25.42	2.02	0.00	3.55	1.83	1.73	10.04	0.04	0.10	0.00	0.00	10.02	105.83	52.49	86.48	8.19	40.80	103.80	19.86	1
6193.6	6.69	26.81	1.99	0.40	3.75	2.24	1.25	9.82	0.04	0.09	0.00	140.09	10.34	115.93	66.55	83.16	6.27	41.58	133.71	25.78	1
6194.0	7.27	26.85	2.17	0.00	3.66	2.22	1.90	9.87	0.04	0.06	0.00	0.00	0.00	101.92	63.44	101.86	8.05	106.74	122.59	24.95	1
6194.6	6.55	25.70	2.00	0.40	3.40	1.78	1.29	9.90	0.04	0.09	0.00	121.96	12.28	118.90	38.97	82.31	8.66	41.44	131.58	13.54	1
6195.0	6.18	24.85	2.04	0.36	3.29	1.61	1.65	10.05	0.04	0.12	0.00	114.80	0.00	90.73	42.13	79.00	9.22	41.13	125.66	20.37	1
6195.6	5.92	23.68	2.02	0.37	3.90	2.27	1.02	10.24	0.04	0.08	5.02	126.51	0.00	103.93	56.13	96.93	8.35	42.21	136.71	23.66	2
6196.0	4.88	15.30	1.18	8.22	2.87	1.04	1.21	7.41	0.04	0.00	4.60	0.00	9.23	87.03	33.39	63.06	8.65	37.89	108.07	23.40	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6196.6	5.49	22.65	1.77	0.00	3.40	2.15	0.86	12.88	0.05	0.12	0.00	0.00	0.00	98.80	47.75	87.27	7.70	87.85	128.74	23.18	1
6197.0	6.73	25.15	2.03	1.76	3.70	1.72	1.38	7.17	0.03	0.00	0.00	0.00	0.00	104.48	51.09	111.94	12.06	113.07	137.97	18.29	1
6197.6	6.72	27.71	2.23	0.44	3.78	1.93	0.65	6.40	0.03	0.10	0.00	125.08	13.04	115.47	40.43	79.77	22.85	48.22	136.74	24.22	1
6198.0	7.79	29.07	2.35	0.47	3.73	1.91	1.39	6.60	0.03	0.08	0.00	154.23	0.00	85.29	61.32	91.87	9.62	48.67	138.79	25.11	1
6198.6	7.51	26.84	2.28	0.46	4.03	2.11	1.40	8.65	0.03	0.08	5.72	138.85	15.85	109.70	69.17	117.96	26.96	44.96	137.02	24.99	1
6199.0	6.26	24.58	1.90	0.00	3.55	1.96	1.58	11.22	0.03	0.12	0.00	0.00	0.00	108.43	39.85	83.42	8.74	39.65	114.45	17.45	1
6199.6	7.23	26.51	2.17	0.00	3.85	2.22	1.46	9.07	0.04	0.05	0.00	0.00	0.00	122.50	43.76	86.92	9.07	110.11	135.01	21.91	1
6200.0	7.09	26.05	2.08	1.27	4.11	2.12	1.68	7.28	0.03	0.00	0.00	0.00	0.00	87.35	60.78	63.21	9.68	111.78	132.24	23.69	1
6200.6	6.69	25.18	2.01	0.41	4.17	2.41	1.33	10.87	0.04	0.10	0.00	134.47	10.57	93.33	51.31	66.37	25.31	40.45	149.30	22.63	1
6201.0	6.84	25.55	2.12	0.00	3.73	2.03	1.59	10.10	0.04	0.12	0.00	0.00	0.00	103.00	51.78	94.45	7.32	104.06	140.25	24.10	1
6201.6	7.46	27.64	2.39	0.00	3.86	1.93	1.62	6.83	0.03	0.09	0.00	0.00	0.00	120.16	38.38	95.11	8.94	115.39	142.98	21.12	1
6202.0	7.74	28.53	2.37	0.46	3.77	2.17	1.58	6.48	0.03	0.08	0.00	145.06	8.29	92.01	47.82	80.77	9.18	46.20	138.51	18.68	1
6202.6	7.93	29.06	2.37	0.00	3.84	2.41	2.03	6.10	0.03	0.05	0.00	0.00	0.00	93.46	63.60	71.00	7.97	116.52	139.76	18.81	1
6203.0	6.98	26.22	2.25	0.00	3.74	1.93	1.02	8.58	0.03	0.13	0.00	0.00	0.00	115.32	55.84	87.58	9.83	45.77	120.52	16.45	1
6203.6	6.98	25.44	2.16	0.00	3.64	1.85	0.82	9.71	0.03	0.11	0.00	0.00	0.00	96.06	47.04	96.99	8.96	42.09	121.83	23.04	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6204.0	6.43	24.29	1.81	0.00	3.40	1.71	1.09	13.05	0.05	0.08	0.00	0.00	0.00	99.65	54.18	120.56	10.49	91.34	157.05	18.31	1
6204.6	7.72	27.25	2.37	0.43	3.21	1.63	0.99	8.14	0.04	0.15	0.00	122.98	14.69	98.97	47.04	132.99	10.73	45.41	174.66	21.28	1
6205.0	6.23	24.79	1.96	0.00	3.42	1.78	1.22	11.56	0.04	0.21	0.00	0.00	0.00	87.23	56.59	128.27	9.93	95.41	156.90	15.91	1
6205.6	7.20	26.61	2.22	0.00	3.57	1.63	0.99	8.87	0.04	0.13	0.00	0.00	0.00	89.36	39.37	92.52	13.02	106.08	156.85	12.90	1
6206.0	7.05	27.01	2.25	0.69	3.67	1.73	1.44	7.43	0.03	0.13	0.00	136.13	0.00	93.73	56.86	70.94	10.10	47.48	147.58	14.62	1
6206.6	8.31	27.48	2.48	0.00	3.86	1.96	1.85	6.44	0.02	0.09	0.00	0.00	0.00	93.79	48.20	82.69	9.38	49.89	118.42	19.65	1
6207.0	7.92	26.23	2.43	0.00	4.15	2.13	1.58	6.38	0.02	0.04	0.00	0.00	9.59	98.70	40.57	92.74	8.74	51.49	112.03	24.39	1
6207.6	3.34	11.86	1.36	0.14	2.14	0.88	0.00	28.87	0.10	0.11	0.00	40.92	0.00	78.54	26.79	165.64	7.87	46.30	65.81	0.00	4
6208.0	6.37	23.25	1.80	0.00	3.39	1.83	1.64	12.87	0.05	0.17	0.00	0.00	0.00	98.39	56.12	191.82	10.37	85.66	159.98	12.41	1
6208.6	6.51	22.57	2.23	0.00	3.52	2.17	1.28	9.21	0.04	0.10	0.00	0.00	0.00	86.27	52.87	88.93	8.25	108.92	130.53	17.23	1
6209.0	5.81	19.45	1.74	0.32	3.31	1.78	1.22	14.80	0.06	0.00	0.00	97.77	0.00	98.24	50.94	182.18	9.81	39.42	119.80	14.00	1
6209.6	7.00	23.06	2.32	0.43	3.56	1.67	1.02	9.86	0.04	0.11	0.00	123.56	0.00	83.44	39.78	62.20	8.39	45.23	137.43	15.11	1
6210.0	6.27	21.80	2.02	1.16	3.46	1.35	0.95	9.91	0.04	0.10	0.00	110.57	0.00	108.98	38.22	64.77	11.43	43.55	141.84	12.95	1
6210.6	6.42	22.30	2.11	0.42	3.55	1.54	1.32	9.86	0.04	0.03	0.00	144.52	12.39	105.84	42.93	65.71	11.40	45.46	138.08	12.62	1
6211.0	5.48	20.51	2.00	0.41	3.64	1.64	1.15	11.23	0.05	0.03	0.00	119.02	0.00	94.26	51.97	79.78	8.92	41.63	140.54	17.71	1
6211.6	5.46	21.52	1.77	0.00	3.53	1.91	1.38	13.60	0.04	0.07	0.00	0.00	0.00	111.27	35.77	82.71	12.76	34.07	117.36	15.20	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6212.0	7.14	24.21	2.27	0.40	3.57	2.14	0.94	10.34	0.05	0.04	0.00	110.72	0.00	83.85	41.91	55.71	11.72	43.19	127.29	11.55	1
6212.6	6.68	24.13	2.10	0.00	3.57	1.75	1.11	10.33	0.04	0.11	0.00	0.00	15.62	110.34	34.71	58.67	12.74	43.03	108.82	16.72	1
6213.0	7.24	24.86	2.26	0.42	3.64	1.90	1.32	9.17	0.04	0.10	0.00	137.86	0.00	92.99	34.36	54.75	8.02	44.93	136.74	14.25	1
6213.6	6.32	22.61	1.89	0.00	3.51	2.07	1.12	13.64	0.05	0.17	0.00	0.00	0.00	112.85	49.75	86.85	10.35	36.30	133.86	17.34	1
6214.0	6.89	23.07	2.08	0.72	3.83	2.17	1.44	12.14	0.04	0.10	0.00	0.00	0.00	99.34	53.54	48.58	9.03	40.31	113.97	15.61	1
6214.6	7.04	23.45	2.08	0.40	3.58	1.90	1.72	11.73	0.05	0.14	0.00	89.70	16.03	93.75	44.87	47.99	11.27	42.22	142.76	15.61	1
6215.0	5.92	22.11	1.87	0.39	3.69	1.95	0.81	12.38	0.05	0.13	0.00	98.98	0.00	105.39	42.71	62.18	11.72	38.55	133.23	15.47	1
6215.6	6.90	23.21	1.98	0.40	3.58	1.67	1.56	12.59	0.05	0.12	0.00	96.19	15.68	91.07	50.54	46.75	9.09	41.11	139.48	18.13	1
6216.0	7.09	22.57	2.20	0.94	3.58	1.74	1.54	10.43	0.04	0.18	3.92	0.00	0.00	101.03	47.74	52.23	10.61	44.40	125.52	13.29	1
6216.6	7.13	24.27	2.20	0.43	3.64	2.13	1.55	11.17	0.05	0.13	0.00	109.78	0.00	98.27	63.56	45.82	13.06	42.99	145.41	14.74	1
6217.0	6.22	21.81	1.98	0.54	3.54	1.69	1.34	12.69	0.06	0.12	0.00	111.95	0.00	94.71	38.23	49.53	11.03	38.12	159.27	11.99	1
6217.6	6.93	23.88	2.04	0.00	3.59	1.72	1.31	11.62	0.05	0.09	0.00	0.00	0.00	99.62	32.47	57.20	10.05	102.91	147.28	10.52	1
6218.0	6.43	21.85	1.81	0.00	3.56	1.88	1.73	14.04	0.05	0.09	0.00	0.00	11.22	99.55	32.81	76.20	6.48	35.90	113.76	11.70	1
6218.6	6.33	23.61	2.10	0.00	4.08	2.35	1.65	9.85	0.04	0.13	0.00	0.00	0.00	99.88	53.03	84.77	6.81	42.64	118.99	20.88	1
6219.0	6.60	23.44	2.23	0.47	3.77	2.03	1.05	8.97	0.04	0.16	0.00	121.65	0.00	92.30	57.97	70.71	9.16	46.07	144.80	13.64	1
6219.6	7.07	25.06	2.53	0.50	3.82	1.77	0.78	7.16	0.04	0.09	4.23	144.12	0.00	89.35	34.34	61.69	8.98	50.14	139.81	13.06	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6220.0	7.37	25.05	2.26	0.45	3.77	2.20	1.88	8.91	0.04	0.11	0.00	133.93	11.89	100.31	39.80	77.48	8.82	44.61	139.89	14.05	1
6220.6	7.80	26.74	2.37	0.00	3.71	1.96	1.50	8.00	0.04	0.03	0.00	0.00	0.00	110.27	40.37	69.29	7.95	116.63	140.97	14.69	1
6221.0	7.18	25.41	2.31	0.44	3.70	1.84	1.21	8.23	0.04	0.12	0.00	131.72	0.00	106.08	44.24	75.89	8.54	46.03	141.43	13.20	1
6221.6	7.65	26.48	2.31	0.43	3.78	1.87	1.06	8.90	0.04	0.11	0.00	128.10	14.13	103.10	43.40	88.19	11.96	46.30	132.75	18.77	1
6222.0	6.94	24.68	2.33	1.46	3.67	1.72	0.99	6.66	0.03	0.00	0.00	0.00	0.00	91.17	47.55	80.74	7.75	48.12	111.06	17.00	1
6222.6	6.52	25.21	1.96	0.00	3.57	1.82	1.01	10.65	0.05	0.06	0.00	0.00	0.00	107.82	32.57	96.79	7.22	97.37	173.40	13.37	1
6223.0	7.95	26.90	2.40	0.48	3.72	1.66	1.43	8.40	0.04	0.00	0.00	126.96	0.00	88.10	50.28	75.80	11.55	48.68	137.82	10.89	1
6223.6	8.10	27.73	2.54	0.46	3.83	1.92	0.85	6.92	0.04	0.09	3.75	150.48	0.00	96.06	55.51	82.87	9.04	51.94	134.01	16.04	1
6224.0	4.83	19.16	1.47	2.02	3.40	1.70	0.52	15.29	0.05	0.00	0.00	0.00	0.00	89.56	50.96	65.93	5.61	32.11	112.77	16.33	1
6224.6	7.97	26.84	2.57	0.00	3.93	2.03	1.44	6.94	0.03	0.00	0.00	0.00	10.29	97.65	50.92	67.04	9.27	50.16	115.82	14.57	1
6225.0	5.95	22.35	1.90	0.00	3.78	2.58	1.02	13.00	0.06	0.14	0.00	0.00	0.00	113.31	44.25	116.40	10.85	98.44	153.51	17.26	1
6225.6	6.86	24.87	2.27	0.00	3.62	1.83	1.17	9.26	0.04	0.08	0.00	0.00	0.00	90.51	50.23	77.86	11.44	113.24	147.10	10.58	1
6226.0	6.22	25.85	1.87	0.00	3.40	1.61	1.39	10.93	0.04	0.06	0.00	0.00	0.00	66.14	38.65	60.67	10.37	36.91	129.31	13.97	1
6226.6	6.96	24.74	2.31	0.00	3.70	1.87	1.56	9.55	0.04	0.19	3.72	0.00	14.28	104.98	47.90	72.46	9.38	44.70	121.49	14.70	1
6227.0	5.75	19.43	1.83	0.00	3.46	1.88	1.23	16.28	0.06	0.17	0.00	0.00	0.00	84.93	48.62	56.83	9.41	92.10	117.87	8.48	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6227.6	7.37	25.72	2.26	0.43	3.68	2.11	1.15	9.20	0.04	0.20	0.00	127.85	0.00	102.90	54.55	80.84	11.51	45.36	153.03	18.13	1
6228.0	6.31	24.80	1.95	0.66	3.61	1.89	1.44	9.31	0.05	0.14	0.00	126.06	0.00	103.06	43.15	70.41	10.68	42.32	169.26	13.04	1
6228.6	7.20	24.75	2.31	0.00	3.77	2.03	1.38	8.98	0.04	0.18	0.00	0.00	0.00	118.29	64.23	61.38	10.50	46.13	148.59	19.55	1
6229.0	6.86	25.28	2.06	0.00	3.20	1.47	1.76	11.08	0.05	0.13	0.00	0.00	0.00	90.78	41.00	44.05	6.21	100.37	156.93	10.45	1
6229.6	7.41	27.11	2.33	0.00	3.56	1.79	0.91	8.22	0.05	0.09	0.00	0.00	0.00	109.92	35.05	44.71	9.55	107.80	163.89	14.76	1
6230.0	4.25	15.77	1.14	0.21	2.97	1.81	1.24	24.01	0.08	0.24	4.66	42.62	0.00	73.31	42.40	37.79	6.07	21.65	118.78	12.34	4
6230.6	6.59	24.92	2.03	0.43	3.25	1.72	1.07	10.63	0.05	0.14	0.00	140.64	0.00	109.78	32.70	48.96	7.92	42.71	161.53	13.19	1
6231.0	7.03	25.39	2.12	0.00	3.30	1.67	1.21	10.69	0.05	0.10	0.00	0.00	0.00	94.38	42.33	49.71	11.33	103.12	162.78	0.00	1
6231.6	5.11	21.21	2.05	0.42	3.52	1.47	1.27	10.37	0.05	0.09	0.00	114.45	11.53	103.39	34.67	44.27	9.51	42.18	167.65	14.43	1
6232.0	6.71	26.09	2.32	0.71	3.35	1.34	1.11	5.27	0.04	0.11	0.00	113.94	0.00	80.59	35.96	51.68	12.40	50.63	155.45	16.23	1
6232.6	5.99	24.12	2.08	0.00	3.26	1.16	1.17	8.62	0.04	0.06	3.71	0.00	0.00	102.71	38.41	68.69	8.98	48.38	121.46	14.51	1
6233.0	8.34	27.09	2.66	0.46	3.25	1.35	0.90	4.48	0.03	0.13	0.00	123.72	9.72	108.36	48.88	151.25	13.32	53.23	169.01	19.94	1
6233.6	1.02	4.72	0.52	0.04	1.91	0.87	0.00	38.86	0.15	0.00	0.00	0.00	0.00	86.27	37.30	17.02	0.00	13.74	38.27	9.55	4
6234.0	7.32	28.06	2.31	0.49	3.30	1.32	1.81	6.91	0.03	0.18	0.00	144.93	13.05	97.15	30.62	73.11	7.96	47.64	170.11	7.24	1
6234.6	6.66	26.05	2.10	0.45	3.25	1.47	1.10	9.36	0.04	0.13	0.00	127.51	0.00	103.75	38.41	80.57	10.89	43.24	167.62	13.81	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6235.0	6.80	26.39	2.34	0.49	3.42	1.64	0.44	7.70	0.04	0.10	0.00	148.32	0.00	94.78	50.13	77.62	12.42	52.00	140.53	17.41	1
6235.6	7.24	27.48	2.50	0.52	3.62	1.72	1.10	6.29	0.03	0.06	0.00	162.55	0.00	106.04	27.98	72.22	9.51	51.53	139.92	18.90	1
6236.0	6.81	27.35	2.29	0.00	3.52	1.71	1.06	7.32	0.03	0.07	0.00	0.00	10.20	106.78	42.59	64.49	9.02	48.42	126.04	16.93	1
6236.6	3.07	12.38	1.49	0.18	2.17	0.87	0.00	27.93	0.10	0.03	0.00	54.97	0.00	109.99	23.09	37.54	6.20	48.06	97.76	6.50	4
6237.0	6.51	23.11	2.20	0.43	3.12	1.33	0.74	10.10	0.05	0.15	0.00	118.15	11.31	98.52	32.36	80.11	10.42	46.39	128.18	10.64	1
6237.6	5.17	23.27	1.64	0.00	2.78	1.09	0.65	14.07	0.06	0.17	0.00	0.00	0.00	104.40	39.26	185.04	8.47	82.74	178.52	11.83	1
6238.0	3.05	15.52	1.62	0.22	2.15	0.84	0.63	22.93	0.07	0.12	0.00	52.29	0.00	99.29	0.00	45.94	4.83	20.72	137.43	10.35	4
6238.6	4.29	21.58	1.31	0.00	2.66	1.16	1.07	16.78	0.05	0.26	0.00	0.00	0.00	99.31	38.54	184.11	7.80	27.53	154.67	10.23	4
6239.0	6.77	26.02	2.32	0.00	3.27	1.58	1.48	7.18	0.03	0.13	0.00	0.00	0.00	102.49	51.35	154.84	11.61	47.25	139.97	9.04	1
6239.6	7.68	26.24	2.56	0.00	3.40	1.62	1.45	5.98	0.03	0.18	0.00	0.00	0.00	112.11	46.64	123.33	9.98	54.13	115.90	13.19	1
6240.0	6.26	25.03	1.98	0.42	3.22	1.75	1.25	10.01	0.05	0.23	0.00	122.85	0.00	111.27	41.99	126.84	10.41	41.64	152.06	16.47	1
6240.6	6.63	24.79	2.02	0.39	2.90	1.41	1.09	11.55	0.05	0.14	0.00	102.80	0.00	85.77	46.18	95.73	10.06	41.87	133.45	9.85	1
6241.0	4.53	19.04	1.33	0.00	2.76	1.59	0.92	19.24	0.08	0.28	0.00	0.00	0.00	102.68	40.55	95.04	10.04	26.96	123.39	10.54	4
6241.6	4.89	20.85	1.67	0.00	2.42	0.98	0.00	15.97	0.07	0.25	0.00	0.00	0.00	83.83	41.98	101.90	10.29	31.13	121.08	8.68	4
6242.0	4.37	19.65	1.20	0.00	2.40	1.01	1.67	20.12	0.07	0.12	0.00	0.00	0.00	94.10	29.90	56.79	6.77	23.53	132.47	8.70	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6242.6	3.98	17.99	1.28	0.00	2.56	1.03	0.00	19.15	0.08	0.19	0.00	0.00	0.00	110.79	31.66	86.10	6.57	71.83	141.95	0.00	4
6243.0	3.96	17.81	1.29	0.30	2.41	1.74	0.91	18.63	0.08	0.09	0.00	86.71	0.00	88.60	26.73	78.32	11.55	27.39	163.28	10.02	1
6243.6	6.84	26.32	2.07	0.00	3.08	1.46	0.95	9.20	0.05	0.14	0.00	0.00	0.00	114.37	36.29	78.38	11.82	108.65	146.47	12.73	1
6244.0	6.36	22.01	1.82	0.36	3.46	2.61	1.19	14.94	0.07	0.18	0.00	107.41	0.00	87.81	75.59	60.57	6.86	41.28	127.70	11.92	1
6244.6	6.20	23.18	1.96	0.40	3.45	2.10	1.55	11.73	0.06	0.15	0.00	107.75	9.58	126.30	45.90	73.78	7.55	41.81	136.63	21.20	1
6245.0	5.90	22.37	1.77	0.00	3.10	1.81	1.13	13.19	0.06	0.10	0.00	0.00	0.00	114.86	45.63	52.41	9.96	93.05	153.07	15.88	1
6245.6	6.53	24.84	2.01	0.00	3.30	1.99	0.76	11.04	0.05	0.11	0.00	0.00	0.00	103.10	44.43	48.13	9.27	97.30	163.21	20.48	1
6246.0	4.92	19.52	1.55	0.00	2.56	0.98	1.05	17.57	0.06	0.15	0.00	0.00	0.00	100.64	43.73	76.62	6.51	32.58	107.40	7.80	4
6246.6	5.73	22.45	1.96	0.00	2.91	1.39	0.81	11.64	0.04	0.20	0.00	0.00	0.00	118.16	33.95	75.22	10.88	42.13	124.20	9.75	1
6247.0	4.83	20.11	1.54	0.00	3.03	1.71	0.78	15.75	0.06	0.19	0.00	0.00	0.00	104.13	43.12	82.89	22.25	33.98	134.22	13.86	4
6247.6	5.09	20.58	1.77	0.38	3.16	1.66	1.63	14.32	0.06	0.17	0.00	98.01	0.00	117.35	39.18	72.00	11.46	39.62	147.79	16.72	1
6248.0	6.01	22.45	2.06	0.00	3.12	1.52	0.65	11.16	0.04	0.10	0.00	0.00	13.06	97.16	36.26	66.79	13.16	41.88	110.66	13.04	1
6248.6	5.33	20.13	1.64	0.00	2.93	1.43	1.88	13.90	0.05	0.05	0.00	0.00	0.00	110.49	45.39	53.37	8.33	39.04	113.80	12.83	1
6249.0	5.94	22.24	1.84	0.00	2.84	0.97	0.84	13.34	0.06	0.10	0.00	0.00	0.00	103.83	27.24	59.34	13.27	95.44	140.97	10.66	1
6249.6	5.77	21.34	1.79	0.34	2.79	0.78	1.84	14.36	0.05	0.05	0.00	106.62	0.00	88.19	0.00	72.86	11.55	38.08	112.71	9.55	1
6250.0	6.85	23.85	2.37	0.00	3.08	1.31	0.80	10.09	0.05	0.17	0.00	0.00	0.00	91.45	33.38	79.45	12.07	114.72	136.50	8.49	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6250.6	7.05	24.30	2.31	0.00	3.11	1.14	0.92	9.18	0.04	0.15	0.00	0.00	0.00	100.18	0.00	68.51	6.83	117.29	151.07	10.85	1
6251.0	4.43	13.71	0.47	0.00	2.30	1.04	1.05	35.34	0.42	0.00	7.91	0.00	0.00	100.21	31.65	41.86	51.90	13.53	60.42	0.00	4
6251.6	4.20	18.29	1.32	0.00	2.68	1.05	0.00	18.60	0.06	0.14	0.00	0.00	0.00	102.21	26.27	54.75	9.26	31.51	117.96	9.71	4
6252.0	3.64	16.25	1.04	0.21	2.39	0.88	1.07	23.38	0.08	0.14	0.00	59.01	0.00	97.54	28.26	156.94	6.39	53.71	117.49	7.67	4
6252.6	4.25	18.30	1.29	0.27	2.42	0.83	1.01	20.61	0.07	0.09	0.00	72.50	0.00	85.40	34.52	76.88	7.95	23.31	120.37	0.00	1
6253.0	6.32	23.36	1.97	0.00	2.82	0.97	1.52	11.25	0.04	0.14	0.00	0.00	0.00	106.85	32.33	63.98	9.80	41.57	119.74	10.83	1
6253.6	5.10	22.40	1.49	0.37	2.80	1.08	0.85	16.22	0.07	0.15	0.00	87.18	0.00	108.28	32.73	65.05	9.56	30.86	162.95	10.25	1
6254.0	6.38	24.74	1.97	0.00	3.02	1.29	1.06	12.02	0.04	0.18	0.00	0.00	0.00	102.50	28.45	69.13	28.56	39.95	132.10	12.91	4
6254.6	6.48	24.46	1.98	0.00	2.93	1.36	1.18	12.41	0.05	0.12	0.00	0.00	0.00	92.74	29.84	54.46	8.89	39.05	128.35	11.22	1
6255.0	6.77	23.35	2.17	0.00	2.94	2.61	1.18	9.71	0.04	0.10	0.00	0.00	12.94	97.96	38.65	72.32	10.65	44.75	133.16	18.40	1
6255.6	6.48	22.55	1.61	0.00	2.47	1.41	1.08	18.92	0.07	0.08	0.00	0.00	0.00	84.85	0.00	59.72	6.49	27.33	99.66	8.95	4
6256.0	2.71	10.27	0.78	0.00	2.02	0.66	0.00	32.58	0.11	0.06	0.00	0.00	0.00	78.24	0.00	36.18	0.00	43.52	62.88	0.00	4
6256.6	6.04	24.25	1.83	0.42	3.00	1.23	0.80	12.89	0.05	0.10	0.00	96.47	10.65	100.49	33.94	56.76	9.84	36.58	158.63	13.53	1
6257.0	6.04	24.33	2.05	0.45	3.02	1.23	0.93	10.65	0.05	0.14	0.00	102.40	0.00	78.33	39.86	54.20	10.30	41.08	159.67	12.13	1
6257.6	7.27	26.14	2.30	0.47	3.05	1.36	1.88	9.33	0.04	0.11	0.00	129.65	10.86	114.82	37.84	65.83	10.39	47.00	141.66	12.10	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6258.0	8.43	29.84	2.46	0.51	3.18	1.28	1.32	7.42	0.04	0.03	0.00	141.59	0.00	102.30	42.60	55.36	9.08	44.80	146.15	8.74	1
6258.6	6.49	24.98	2.01	0.00	3.18	1.31	1.91	11.39	0.04	0.14	0.00	0.00	10.92	101.87	36.62	73.29	10.41	39.42	118.40	12.84	1
6259.0	6.57	26.05	2.00	0.00	2.96	1.03	1.11	10.78	0.05	0.14	0.00	0.00	0.00	101.45	0.00	60.03	8.88	95.58	142.25	10.35	1
6259.6	6.24	25.17	1.98	0.40	2.94	1.14	0.81	11.13	0.05	0.14	0.00	114.16	0.00	85.53	46.67	62.31	11.61	40.52	138.59	12.16	1
6260.0	5.35	23.26	1.56	0.00	2.73	1.15	1.05	15.90	0.07	0.16	0.00	0.00	0.00	82.33	37.67	71.64	8.36	31.49	119.00	9.95	4
6260.6	1.86	8.49	1.11	0.12	1.95	1.78	0.87	32.54	0.16	0.02	0.00	31.76	0.00	94.95	0.00	88.29	34.17	42.66	55.28	8.77	4
6261.0	4.35	19.73	1.33	0.28	2.70	1.26	0.98	16.83	0.08	0.12	0.00	69.44	0.00	112.48	27.44	100.42	8.30	28.71	138.63	10.87	1
6261.6	7.56	28.32	2.29	0.44	3.03	1.21	1.62	8.14	0.05	0.09	0.00	125.43	11.16	97.01	31.58	69.46	8.88	45.75	134.47	14.23	1
6262.0	5.25	21.80	1.50	0.30	2.63	1.06	1.02	16.86	0.09	0.03	0.00	72.79	0.00	105.37	30.60	75.79	9.99	33.53	122.01	7.11	1
6262.6	5.50	24.41	1.61	0.00	2.75	1.00	1.87	12.69	0.05	0.07	0.00	0.00	11.15	108.40	28.51	67.23	26.07	36.42	110.11	9.83	1
6263.0	4.72	21.72	1.39	0.00	2.61	0.92	0.77	16.30	0.07	0.03	0.00	0.00	0.00	67.75	27.44	64.82	9.44	81.75	110.44	10.12	1
6263.6	5.38	24.63	1.55	0.00	2.65	1.07	0.86	15.63	0.06	0.09	0.00	0.00	0.00	86.19	33.04	65.90	7.80	30.92	96.17	9.55	4
6264.0	5.55	26.20	1.70	0.00	2.51	0.88	1.51	12.73	0.06	0.03	0.00	0.00	0.00	110.67	0.00	64.63	9.95	87.48	128.45	11.30	1
6264.6	5.62	26.59	1.73	0.00	2.68	1.05	1.07	11.65	0.06	0.06	0.00	0.00	0.00	91.28	39.60	92.87	9.12	93.79	142.19	10.62	1
6265.0	6.21	27.31	1.92	0.37	2.72	1.01	1.50	9.81	0.05	0.00	0.00	111.05	9.66	75.08	33.92	82.16	8.73	39.65	133.54	13.33	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6265.6	7.38	29.80	2.31	0.00	2.67	0.97	1.00	7.13	0.04	0.10	0.00	0.00	0.00	76.13	26.68	78.96	11.68	109.59	142.15	11.63	1
6266.0	1.78	7.51	0.37	0.00	1.66	0.76	1.96	36.87	0.21	0.08	0.00	0.00	0.00	104.30	32.27	24.00	0.00	24.01	42.58	9.20	4
6266.6	5.58	26.73	1.68	0.00	2.50	0.86	1.53	12.74	0.04	0.03	0.00	0.00	0.00	85.35	36.19	77.17	8.47	34.98	102.29	8.05	1
6267.0	4.28	22.67	1.35	0.31	2.53	0.90	1.30	16.10	0.07	0.13	0.00	90.05	0.00	111.19	37.37	109.72	6.71	28.83	170.69	12.23	1
6267.6	5.98	25.63	1.83	0.00	2.82	0.83	1.85	12.23	0.05	0.08	0.00	0.00	0.00	115.99	29.97	69.74	9.47	93.17	127.69	7.88	1
6268.0	7.76	28.68	2.50	0.00	2.79	1.02	1.71	8.00	0.03	0.05	0.00	0.00	10.65	104.79	42.55	75.35	9.99	49.03	100.76	11.30	1
6268.6	5.04	22.78	1.50	0.00	2.44	0.90	0.80	16.99	0.07	0.09	0.00	0.00	0.00	86.18	29.06	70.49	8.92	82.48	117.57	0.00	1
6269.0	4.68	22.01	1.72	0.00	2.80	1.83	0.83	13.20	0.05	0.10	0.00	0.00	11.93	86.21	34.42	59.75	9.41	35.87	116.33	13.14	1
6269.6	7.11	26.60	2.12	0.00	3.02	1.42	1.32	9.90	0.05	0.14	0.00	0.00	0.00	107.30	0.00	65.55	10.85	103.85	128.64	11.30	1
6270.0	6.06	23.58	1.64	0.32	2.91	1.35	1.53	15.55	0.07	0.10	0.00	89.44	0.00	120.98	30.45	51.13	6.99	34.46	127.30	8.06	1
6270.6	3.21	13.00	0.85	0.00	2.09	0.84	0.72	28.59	0.13	0.08	0.00	0.00	0.00	102.62	31.52	39.34	7.42	56.43	77.75	0.00	4
6271.0	6.37	25.76	2.03	0.38	2.96	1.37	1.43	11.01	0.05	0.14	0.00	97.67	0.00	92.99	29.34	64.14	9.58	38.83	134.47	9.18	1
6271.6	5.68	21.90	1.69	0.32	2.52	1.05	1.16	17.20	0.07	0.14	0.00	93.58	0.00	103.92	30.19	47.57	26.46	35.91	110.52	10.74	4
6272.0	5.13	21.35	1.42	0.00	2.63	0.98	1.17	17.30	0.07	0.08	0.00	0.00	0.00	100.09	39.89	45.34	6.51	30.64	96.89	12.92	4
6272.6	5.61	23.76	1.78	0.00	2.67	1.06	1.03	14.49	0.05	0.07	0.00	0.00	0.00	84.40	29.98	58.81	9.49	36.34	115.78	9.09	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6273.0	6.98	23.75	2.11	0.42	2.66	1.30	1.01	11.06	0.07	0.07	0.00	122.97	12.68	86.62	52.91	49.57	17.94	45.47	149.98	9.93	1
6273.6	7.21	25.43	2.16	0.00	3.07	1.28	1.57	11.07	0.04	0.05	0.00	0.00	0.00	90.53	35.47	41.71	12.99	44.87	106.98	14.40	1
6274.0	5.41	22.58	1.92	0.00	2.85	1.07	1.09	11.40	0.06	0.06	0.00	0.00	0.00	91.34	30.55	52.03	9.68	96.11	132.82	9.34	1
6274.6	7.08	25.25	2.22	0.00	2.96	1.21	1.21	10.25	0.04	0.17	0.00	0.00	0.00	92.59	35.27	58.54	12.03	44.28	107.19	11.73	1
6275.0	4.99	20.00	1.54	0.30	2.39	0.91	1.23	19.36	0.07	0.15	0.00	82.60	0.00	101.13	0.00	37.06	9.30	26.28	98.90	8.30	1
6275.6	6.84	23.84	2.07	0.00	2.97	1.22	1.73	12.97	0.06	0.22	0.00	0.00	0.00	92.46	30.13	60.72	8.45	99.93	128.13	10.07	1
6276.0	3.39	15.64	1.50	0.19	2.12	0.70	0.88	26.04	0.13	0.20	0.00	45.66	0.00	85.06	27.30	204.57	35.92	19.84	84.16	0.00	4
6276.6	6.33	23.92	1.81	0.00	2.72	0.89	1.77	13.90	0.07	0.21	0.00	0.00	0.00	102.65	43.42	63.37	9.56	92.32	127.17	8.40	1
6277.0	4.31	18.14	1.38	0.27	2.44	0.87	0.71	19.24	0.07	0.11	0.00	67.08	0.00	111.37	31.99	55.96	8.32	30.05	110.80	6.69	1
6277.6	8.22	26.28	2.59	0.00	2.80	1.07	0.81	7.81	0.04	0.09	0.00	0.00	0.00	104.94	27.39	50.87	17.82	52.17	114.80	0.00	1
6278.0	4.70	16.05	1.23	1.33	2.69	1.27	1.00	21.20	0.12	0.00	0.00	0.00	0.00	88.37	28.43	62.65	6.48	28.64	89.80	9.17	1
6278.6	4.24	18.49	1.38	0.00	2.62	0.89	0.62	18.05	0.07	0.11	0.00	0.00	0.00	95.24	0.00	40.01	8.14	28.39	104.75	10.12	4
6279.0	6.75	24.30	2.28	0.46	3.07	1.24	1.38	9.55	0.05	0.05	0.00	142.83	0.00	95.94	27.99	56.01	8.75	48.54	142.71	14.43	1
6279.6	7.41	26.63	2.26	0.00	3.22	1.55	0.95	9.09	0.04	0.06	0.00	0.00	9.64	101.39	47.26	59.11	10.98	47.12	115.01	13.54	1
6280.0	4.70	17.05	1.12	0.00	2.76	0.90	1.12	22.96	0.08	0.06	0.00	0.00	0.00	92.97	34.28	42.80	33.89	30.00	94.93	0.00	4
6280.6	7.07	25.02	2.25	0.43	3.26	1.49	1.02	10.40	0.05	0.06	0.00	104.40	0.00	102.31	40.69	47.90	10.09	45.81	138.86	12.67	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6280.6	7.07	25.02	2.25	0.43	3.26	1.49	1.02	10.40	0.05	0.06	0.00	104.40	0.00	102.31	40.69	47.90	10.09	45.81	138.86	12.67	1
6281.0	6.50	24.41	2.24	0.45	3.13	1.67	0.66	8.46	0.04	0.04	0.00	135.96	14.29	93.87	36.66	44.68	8.63	47.10	139.15	14.29	1
6281.6	5.89	22.26	2.08	0.42	3.22	1.42	1.13	8.13	0.04	0.05	0.00	117.63	0.00	104.20	27.33	50.48	9.63	47.21	135.75	13.65	1
6282.0	4.32	19.33	1.41	0.00	2.69	1.20	1.21	16.40	0.07	0.11	0.00	0.00	0.00	110.73	36.57	58.51	9.57	74.86	152.55	0.00	1
6282.6	5.03	19.00	1.69	0.35	2.99	1.36	0.88	14.87	0.05	0.00	0.00	106.26	0.00	112.30	42.92	56.32	8.30	37.77	111.86	8.30	1
6283.0	5.51	19.77	1.92	0.35	2.87	1.42	1.45	14.45	0.06	0.07	0.00	105.64	0.00	109.03	46.16	60.66	11.01	37.85	123.54	12.72	1
6283.6	4.58	19.35	1.58	0.31	2.87	1.35	0.95	14.57	0.07	0.10	0.00	95.26	14.83	94.57	42.69	66.25	7.91	32.22	141.71	9.44	1
6284.0	5.67	19.02	2.05	1.72	2.73	0.94	1.43	9.36	0.05	0.00	0.00	0.00	0.00	109.80	38.74	46.22	11.22	111.11	137.37	10.50	1
6284.6	3.34	12.31	1.01	0.00	2.41	1.01	0.00	25.51	0.12	0.06	0.00	0.00	0.00	104.90	0.00	55.50	6.49	24.17	79.66	10.59	4
6285.0	5.60	21.26	1.97	0.00	2.82	0.92	0.76	11.76	0.05	0.08	0.00	0.00	0.00	93.68	34.16	70.76	8.45	99.30	139.06	9.96	1
6285.6	6.49	23.20	2.07	0.41	2.73	1.05	1.26	10.43	0.05	0.18	0.00	105.82	0.00	100.89	34.31	79.68	14.99	43.22	162.83	14.32	1
6280.6	7.07	25.02	2.25	0.43	3.26	1.49	1.02	10.40	0.05	0.06	0.00	104.40	0.00	102.31	40.69	47.90	10.09	45.81	138.86	12.67	1
6281.0	6.50	24.41	2.24	0.45	3.13	1.67	0.66	8.46	0.04	0.04	0.00	135.96	14.29	93.87	36.66	44.68	8.63	47.10	139.15	14.29	1
6281.6	5.89	22.26	2.08	0.42	3.22	1.42	1.13	8.13	0.04	0.05	0.00	117.63	0.00	104.20	27.33	50.48	9.63	47.21	135.75	13.65	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6280.6	7.07	25.02	2.25	0.43	3.26	1.49	1.02	10.40	0.05	0.06	0.00	104.40	0.00	102.31	40.69	47.90	10.09	45.81	138.86	12.67	1
6281.0	6.50	24.41	2.24	0.45	3.13	1.67	0.66	8.46	0.04	0.04	0.00	135.96	14.29	93.87	36.66	44.68	8.63	47.10	139.15	14.29	1
6281.6	5.89	22.26	2.08	0.42	3.22	1.42	1.13	8.13	0.04	0.05	0.00	117.63	0.00	104.20	27.33	50.48	9.63	47.21	135.75	13.65	1
6282.0	4.32	19.33	1.41	0.00	2.69	1.20	1.21	16.40	0.07	0.11	0.00	0.00	0.00	110.73	36.57	58.51	9.57	74.86	152.55	0.00	1
6282.6	5.03	19.00	1.69	0.35	2.99	1.36	0.88	14.87	0.05	0.00	0.00	106.26	0.00	112.30	42.92	56.32	8.30	37.77	111.86	8.30	1
6283.0	5.51	19.77	1.92	0.35	2.87	1.42	1.45	14.45	0.06	0.07	0.00	105.64	0.00	109.03	46.16	60.66	11.01	37.85	123.54	12.72	1
6283.6	4.58	19.35	1.58	0.31	2.87	1.35	0.95	14.57	0.07	0.10	0.00	95.26	14.83	94.57	42.69	66.25	7.91	32.22	141.71	9.44	1
6284.0	5.67	19.02	2.05	1.72	2.73	0.94	1.43	9.36	0.05	0.00	0.00	0.00	0.00	109.80	38.74	46.22	11.22	111.11	137.37	10.50	1
6284.6	3.34	12.31	1.01	0.00	2.41	1.01	0.00	25.51	0.12	0.06	0.00	0.00	0.00	104.90	0.00	55.50	6.49	24.17	79.66	10.59	4
6285.0	5.60	21.26	1.97	0.00	2.82	0.92	0.76	11.76	0.05	0.08	0.00	0.00	0.00	93.68	34.16	70.76	8.45	99.30	139.06	9.96	1
6285.6	6.49	23.20	2.07	0.41	2.73	1.05	1.26	10.43	0.05	0.18	0.00	105.82	0.00	100.89	34.31	79.68	14.99	43.22	162.83	14.32	1
6286.0	5.29	19.22	1.69	2.22	2.53	0.88	0.97	11.76	0.05	0.00	0.00	0.00	10.47	97.55	35.43	64.80	10.72	39.99	108.35	0.00	1
6286.6	5.21	20.97	1.63	0.00	2.54	1.00	0.91	15.05	0.05	0.14	0.00	0.00	12.22	94.72	33.95	53.32	29.07	34.99	119.68	12.11	1
6287.0	4.94	20.69	1.64	0.38	2.95	1.67	0.79	13.94	0.06	0.10	0.00	91.06	9.71	124.43	27.39	75.84	8.05	34.58	156.34	14.71	1
6287.6	2.31	9.13	0.57	0.00	5.21	5.21	1.08	29.82	0.17	0.12	0.00	0.00	0.00	98.02	43.99	80.67	0.00	37.41	100.58	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6288.0	5.27	19.35	1.63	0.85	3.09	1.81	0.56	14.94	0.07	0.09	0.00	82.30	10.40	110.59	36.15	68.54	9.36	36.54	134.45	14.96	1
6288.6	5.66	20.88	1.85	0.00	2.93	1.49	0.71	13.38	0.06	0.12	0.00	0.00	10.78	107.84	31.95	54.10	8.85	38.23	110.42	12.32	1
6289.0	5.69	21.84	1.61	0.74	2.76	1.15	1.17	14.20	0.06	0.06	0.00	77.91	0.00	84.89	29.74	52.20	9.34	35.21	120.29	8.46	1
6289.6	5.70	22.01	1.87	0.38	2.76	1.14	1.00	12.97	0.06	0.09	0.00	111.98	14.42	95.48	35.02	51.39	22.74	37.69	142.61	13.25	1
6290.0	5.39	19.14	1.80	1.06	2.68	1.01	0.88	13.08	0.06	0.00	0.00	0.00	0.00	97.32	41.82	81.05	12.19	93.43	134.17	10.25	1
6290.6	3.62	16.83	1.47	0.30	2.67	0.96	0.00	16.98	0.07	0.09	0.00	70.65	0.00	95.65	29.85	65.74	7.71	32.25	139.14	11.25	4
6291.0	4.86	20.01	1.63	0.35	2.63	0.92	1.01	15.46	0.06	0.11	0.00	84.27	0.00	107.71	27.73	42.73	8.56	33.50	144.69	9.67	1
6291.6	6.48	23.76	2.13	0.00	2.84	1.03	0.65	10.36	0.04	0.08	0.00	0.00	0.00	77.33	26.22	106.62	7.83	42.83	122.11	11.65	1
6292.0	6.01	23.39	2.04	0.00	2.90	1.16	1.14	10.31	0.04	0.05	0.00	0.00	0.00	94.99	37.09	56.08	8.08	101.56	166.88	14.30	1
6292.6	6.63	23.83	2.27	0.00	2.94	1.08	1.18	8.80	0.04	0.00	0.00	0.00	0.00	101.77	37.19	53.47	10.76	115.01	138.20	12.61	1
6293.0	5.41	19.89	1.79	0.00	3.04	1.44	0.64	15.14	0.06	0.05	0.00	0.00	0.00	117.50	39.28	59.06	10.08	102.68	123.85	12.24	1
6293.6	6.49	23.15	2.11	0.40	2.90	1.25	0.98	10.87	0.05	0.02	0.00	107.71	0.00	91.54	30.19	48.71	32.52	43.53	119.58	14.82	4
6294.0	4.16	13.40	1.56	0.17	2.25	0.98	0.00	28.64	0.11	0.05	0.00	42.39	0.00	109.38	0.00	67.47	5.36	21.67	86.82	8.41	4
6294.6	5.35	19.86	1.66	0.33	2.67	1.04	1.34	16.03	0.07	0.08	0.00	109.77	0.00	104.95	35.34	73.42	7.96	35.30	126.25	8.46	1
6295.0	5.37	19.85	1.77	0.34	2.99	1.37	1.38	15.23	0.06	0.12	0.00	101.88	11.20	111.94	31.21	63.82	9.88	35.76	144.34	13.47	1
6295.6	6.20	21.13	2.00	0.37	2.91	1.07	1.45	13.56	0.06	0.11	0.00	103.60	0.00	97.87	45.85	95.12	10.54	40.50	133.47	10.44	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6296.0	6.30	21.15	2.03	1.53	3.02	1.37	1.18	11.08	0.05	0.00	0.00	118.69	0.00	96.08	42.13	71.99	9.91	42.93	145.12	14.90	1
6296.6	6.39	22.53	2.10	0.39	2.94	1.26	1.02	11.86	0.05	0.08	0.00	111.63	10.53	106.78	21.25	74.74	8.28	41.47	136.23	14.87	1
6297.0	5.80	21.15	1.92	0.00	2.93	1.38	1.14	12.30	0.05	0.07	0.00	0.00	0.00	78.52	26.56	63.30	8.49	101.16	120.47	16.29	1
6297.6	6.34	22.27	2.08	0.00	3.04	1.51	0.71	12.42	0.04	0.00	0.00	0.00	11.62	95.35	40.11	49.72	11.73	43.47	113.25	12.41	1
6298.0	5.35	21.02	2.02	0.00	2.80	1.13	0.71	13.17	0.05	0.00	0.00	0.00	12.06	69.15	48.27	34.38	7.82	39.77	103.75	12.70	1
6298.6	6.39	23.03	1.96	0.00	2.87	1.25	1.21	12.98	0.05	0.00	0.00	0.00	0.00	108.53	27.21	40.50	11.06	99.48	132.28	14.43	1
6299.0	5.67	21.26	1.92	0.00	2.92	1.19	1.09	12.85	0.06	0.03	0.00	0.00	0.00	85.51	46.38	40.58	7.10	97.55	137.17	9.33	1
6299.6	6.13	22.32	2.05	0.00	3.03	1.24	1.33	10.83	0.04	0.05	0.00	0.00	0.00	105.48	44.14	54.56	11.31	43.47	104.17	13.99	1
6300.0	6.17	20.87	1.86	1.66	2.76	1.01	1.42	12.00	0.04	0.00	0.00	0.00	13.96	102.89	26.75	66.88	8.71	42.45	106.93	8.91	1
6300.6	6.57	22.51	1.98	0.00	2.86	1.12	1.56	12.91	0.05	0.06	0.00	0.00	11.91	105.31	59.57	45.16	10.57	41.74	107.99	11.73	1
6301.0	7.12	23.51	2.17	0.00	3.10	1.37	1.56	11.72	0.05	0.04	0.00	0.00	0.00	91.39	34.67	43.75	8.48	105.56	133.57	9.06	1
6301.6	4.92	19.16	1.61	0.00	3.06	1.48	0.00	15.94	0.06	0.07	0.00	0.00	0.00	98.48	31.57	35.73	7.00	99.06	124.96	14.80	1
6302.0	5.01	20.73	1.93	0.00	2.75	1.18	0.91	11.96	0.06	0.06	0.00	0.00	0.00	73.55	31.27	45.85	10.75	100.75	121.73	9.61	1
6302.6	5.90	21.25	1.76	0.00	3.14	1.65	1.55	14.97	0.05	0.08	0.00	0.00	0.00	110.80	45.02	37.87	6.91	38.59	103.33	15.29	1
6303.0	6.63	24.21	2.08	0.00	3.09	1.46	1.00	10.13	0.05	0.00	0.00	0.00	0.00	97.95	34.72	23.80	11.84	107.72	136.17	14.27	1
6303.6	3.63	15.64	0.99	0.00	2.36	0.81	0.85	23.49	0.12	0.19	0.00	0.00	0.00	101.08	0.00	49.93	30.10	21.55	80.37	8.72	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6304.0	7.11	24.70	2.24	0.43	3.05	1.34	1.35	10.02	0.05	0.09	0.00	123.58	6.37	93.81	27.71	46.19	10.09	45.07	127.23	12.56	1
6304.6	5.29	20.77	1.57	0.00	2.89	1.52	1.14	17.24	0.07	0.06	0.00	0.00	0.00	79.10	36.86	42.68	5.85	82.21	113.97	10.44	1
6305.0	5.37	22.12	1.85	0.34	2.78	1.15	1.33	12.00	0.05	0.08	0.00	87.37	0.00	84.33	30.63	45.80	10.36	40.55	128.00	10.12	1
6305.6	6.37	23.32	2.00	0.39	2.92	1.40	1.68	11.57	0.06	0.12	0.00	116.24	12.49	109.33	44.26	48.40	8.06	42.47	126.39	10.49	1
6306.0	5.48	20.42	1.69	0.00	2.83	1.22	1.31	15.32	0.06	0.10	0.00	0.00	0.00	94.17	32.12	37.10	8.67	85.82	116.87	16.90	1
6306.6	5.01	21.11	1.55	0.00	3.09	1.93	1.31	16.50	0.07	0.09	5.75	0.00	0.00	122.14	43.03	40.32	7.04	78.56	123.92	18.40	1
6307.0	5.91	22.76	1.85	0.35	3.05	1.98	1.32	13.38	0.07	0.03	0.00	101.00	12.52	98.02	51.16	41.32	9.27	37.50	122.74	12.52	1
6307.6	6.18	24.35	1.89	0.38	3.42	2.33	1.11	11.20	0.06	0.00	0.00	106.97	12.55	120.26	50.41	35.72	8.66	40.20	131.72	14.50	1
6308.0	6.01	23.55	1.90	0.37	2.79	1.37	1.41	12.42	0.05	0.07	0.00	98.14	0.00	100.62	27.91	32.63	11.18	40.08	121.10	13.98	1
6308.6	5.73	23.37	1.83	0.00	2.66	1.43	1.76	13.43	0.06	0.11	0.00	0.00	0.00	123.63	0.00	48.56	9.12	92.32	120.88	14.39	1
6309.0	6.04	24.67	1.82	0.35	2.83	1.53	1.72	11.60	0.05	0.10	0.00	98.63	12.34	90.96	49.96	71.44	9.20	39.28	127.84	14.36	1
6309.6	6.02	24.82	1.98	0.00	2.86	1.60	1.28	10.40	0.04	0.06	0.00	0.00	11.69	101.96	30.76	43.29	7.30	42.20	94.05	11.97	1
6310.0	6.08	24.25	1.95	0.56	2.85	1.36	0.92	10.32	0.05	0.06	0.00	108.48	12.20	100.83	41.45	73.17	10.76	41.63	135.02	10.25	1
6310.6	5.84	23.97	1.82	0.00	2.81	1.45	1.15	11.77	0.05	0.07	0.00	0.00	11.65	110.33	31.54	66.14	24.34	39.39	107.32	12.70	1
6311.0	6.41	25.61	2.13	0.43	3.01	1.49	1.49	8.45	0.04	0.03	0.00	135.72	12.74	106.43	44.95	58.57	14.60	45.04	138.22	12.36	1
6312.0	5.51	24.55	1.78	0.00	2.79	1.56	1.35	12.33	0.05	0.07	0.00	0.00	13.35	102.16	35.43	35.45	25.12	38.11	99.69	8.78	1

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6313	4.86	22.34	1.57	0.29	2.61	1.30	0.99	15.08	0.07	0.10	4.00	87.00	0.00	108.00	44.69	44.56	8.53	33.17	113.35	10.12	1
6314	5.63	24.07	1.71	0.33	2.58	1.36	1.07	13.15	0.05	0.08	0.00	110.42	10.11	93.75	45.18	33.99	7.00	39.29	122.36	9.34	1
6315	6.63	27.51	1.98	0.39	2.98	1.92	1.02	10.14	0.04	0.00	3.60	120.30	9.04	106.56	27.99	31.89	7.54	41.82	120.72	14.38	1
6316	5.15	23.02	1.41	0.29	2.40	1.29	1.44	17.39	0.06	0.06	0.00	66.52	13.11	105.48	32.81	32.18	5.68	28.19	116.66	12.92	1
6317	5.89	25.96	1.90	0.37	2.35	1.09	0.91	11.23	0.05	0.12	0.00	100.46	13.87	115.98	35.25	37.15	9.14	38.70	127.89	12.81	1
6318	5.54	25.03	1.64	0.00	2.32	1.60	0.53	16.17	0.09	0.13	0.00	0.00	0.00	94.78	0.00	31.81	23.63	32.30	81.80	13.42	4
6319	4.03	18.85	1.13	0.00	2.11	0.97	1.46	22.70	0.09	0.10	0.00	0.00	0.00	95.06	32.60	35.04	20.06	23.63	63.47	9.24	4
6320	5.57	23.60	1.60	0.27	2.29	1.25	2.12	16.28	0.09	0.10	0.00	80.89	0.00	112.72	26.51	85.49	5.21	32.30	100.79	10.56	1
6321	5.26	23.18	1.65	0.30	2.32	1.27	1.16	15.42	0.08	0.03	0.00	80.10	0.00	90.01	31.89	31.80	27.05	34.67	105.91	13.71	4
6322	3.93	18.27	1.28	0.00	2.30	1.14	0.00	20.07	0.10	0.10	0.00	0.00	0.00	92.47	39.24	37.98	7.96	63.71	84.44	20.19	4
6323	5.18	20.38	1.48	0.25	2.38	1.39	1.41	18.58	0.10	0.08	0.00	77.69	0.00	101.57	36.23	31.03	8.42	31.69	85.30	21.89	1
6324	4.82	21.26	1.51	0.00	2.14	1.37	0.63	18.68	0.10	0.10	0.00	0.00	0.00	109.02	37.38	29.63	0.00	74.06	92.65	18.39	4
6325	4.11	18.86	1.28	0.00	2.22	1.16	1.00	19.38	0.11	0.23	0.00	0.00	0.00	84.64	30.60	49.56	0.00	70.92	109.68	16.61	4
6326	6.23	26.17	1.81	0.00	2.69	1.87	1.31	13.03	0.06	0.11	0.00	0.00	0.00	108.21	36.23	58.71	7.86	37.44	88.68	15.05	1
6327	6.42	27.30	1.87	0.00	2.46	1.56	1.21	10.85	0.06	0.10	0.00	0.00	0.00	97.35	34.78	51.22	7.85	95.54	111.13	17.07	1
6328	4.60	21.57	1.32	0.00	2.17	1.11	1.10	18.67	0.08	0.12	0.00	0.00	0.00	101.68	28.07	55.56	21.06	26.65	68.79	16.21	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6329	5.23	24.19	1.51	0.26	2.53	1.55	1.77	15.15	0.08	0.12	0.00	91.61	0.00	109.80	28.04	89.39	8.08	30.71	100.06	11.03	1
6330	3.37	18.82	1.01	0.00	1.66	0.99	0.93	23.12	0.10	0.15	0.00	0.00	0.00	101.68	30.00	80.82	0.00	54.64	62.44	10.32	4
6331	4.67	22.80	1.41	0.00	2.05	1.35	1.07	17.12	0.08	0.10	5.21	0.00	0.00	101.78	41.78	73.56	0.00	26.83	71.32	11.89	4
6332	4.58	20.45	1.24	0.00	2.09	1.49	1.16	20.25	0.09	0.06	6.29	0.00	0.00	110.04	47.51	56.68	0.00	25.92	64.00	13.42	4
6333	3.89	18.75	1.12	0.00	2.32	1.41	1.54	21.16	0.10	0.12	0.00	0.00	0.00	91.68	32.98	69.63	0.00	21.74	68.58	13.23	4
6334	5.21	22.93	1.68	0.26	1.96	1.22	1.25	14.86	0.07	0.05	0.00	70.72	0.00	117.05	46.08	25.84	7.61	32.13	88.42	8.84	1
6335	1.43	8.44	0.88	0.06	1.54	1.38	1.06	34.25	0.24	1.30	6.58	0.00	0.00	126.96	38.93	21.81	0.00	28.80	58.10	15.39	4
6336	5.15	22.85	1.61	0.78	1.88	1.24	0.63	15.05	0.08	0.09	5.14	64.26	0.00	105.09	40.12	13.56	6.73	32.88	86.66	10.47	1
6337	4.76	19.42	1.46	0.00	2.70	2.54	1.74	19.47	0.10	0.08	5.38	0.00	0.00	99.33	57.34	23.13	7.06	25.79	81.97	16.07	4
6338	4.71	21.73	1.55	0.23	1.87	1.35	0.89	17.69	0.09	0.10	0.00	55.44	0.00	75.62	53.91	25.87	7.11	27.67	84.37	13.81	1
6339	3.96	17.71	1.24	0.17	1.67	1.11	1.35	21.97	0.11	0.07	0.00	68.19	0.00	95.54	0.00	33.18	7.06	58.90	83.27	6.93	4
6340	3.73	18.58	1.22	0.16	1.60	1.49	0.00	21.07	0.11	0.08	5.34	56.24	0.00	108.00	27.44	36.98	0.00	60.27	75.44	7.63	4
6341	3.17	16.91	1.62	0.13	1.30	1.52	0.00	23.23	0.11	0.13	4.91	39.52	0.00	106.29	25.23	45.26	7.40	46.10	64.18	9.39	4
6342	3.97	17.94	1.22	0.47	1.36	1.16	1.34	20.62	0.10	0.00	7.56	45.27	0.00	95.22	47.83	27.08	6.26	57.11	69.58	8.55	4
6343	3.75	19.07	1.22	0.17	1.99	1.75	1.37	19.47	0.10	0.12	5.03	60.93	0.00	113.42	37.55	34.91	0.00	23.90	74.85	13.15	4
6344	2.14	9.21	0.86	1.20	1.45	1.46	1.00	32.49	0.17	0.05	6.21	0.00	0.00	108.25	37.80	13.28	0.00	24.43	35.33	10.13	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6345	3.50	18.06	1.08	0.15	1.62	1.58	0.77	23.07	0.13	0.09	5.89	31.48	0.00	112.99	44.68	52.65	0.00	49.95	70.95	10.13	4
6346	3.58	16.94	1.13	0.00	1.44	1.50	0.00	23.76	0.12	0.16	10.12	0.00	0.00	107.94	47.08	62.70	6.57	20.81	54.96	8.41	4
6347	2.87	18.29	1.64	0.20	1.11	0.93	0.00	22.78	0.12	0.12	4.37	57.54	0.00	99.55	33.08	31.03	6.64	49.14	75.49	6.93	4
6348	3.79	18.66	1.25	0.17	1.61	1.26	1.45	20.09	0.10	0.13	5.37	49.53	0.00	96.40	42.48	61.46	7.82	26.44	80.34	12.13	4
6349	3.03	17.65	1.58	0.15	1.27	1.18	1.41	23.92	0.12	0.13	5.44	37.01	0.00	107.22	34.08	35.52	0.00	46.45	65.46	7.85	4
6350	3.20	20.21	1.02	0.00	1.43	1.24	0.87	21.97	0.10	0.07	4.74	0.00	0.00	103.11	37.02	46.77	7.21	20.61	53.77	14.28	4
6351	1.81	14.45	0.56	0.00	1.30	1.53	1.04	27.91	0.13	0.23	0.00	0.00	0.00	90.02	34.14	41.65	0.00	11.19	41.28	13.40	4
6352	2.66	17.15	0.91	0.00	1.30	2.23	0.00	22.38	0.11	0.34	0.00	0.00	0.00	97.19	42.52	57.61	6.16	44.28	62.75	10.96	4
6353	2.02	14.10	1.08	0.57	1.00	0.94	0.97	27.91	0.12	0.08	0.00	0.00	0.00	87.01	55.47	34.37	4.31	32.47	56.34	9.94	4
6354	2.93	19.52	0.92	0.00	1.33	1.14	0.59	22.24	0.10	0.11	0.00	0.00	0.00	105.29	40.15	96.80	0.00	17.56	54.19	8.56	4
6355	1.90	15.88	0.92	0.08	0.66	0.72	0.92	28.00	0.12	0.08	0.00	22.62	0.00	77.30	39.45	87.57	5.42	24.61	46.64	0.00	4
6356	1.95	10.66	1.10	0.07	1.08	0.94	0.00	32.27	0.12	0.05	0.00	0.00	0.00	91.41	37.69	15.63	4.61	34.46	52.83	7.88	4
6357	1.81	13.01	0.94	0.08	1.50	1.74	1.50	30.65	0.12	0.21	5.10	0.00	0.00	82.91	37.25	0.00	0.00	29.56	45.83	7.51	4
6358	2.96	17.08	0.89	0.00	1.16	1.17	0.63	24.50	0.12	0.10	0.00	0.00	0.00	112.70	32.98	26.86	7.19	18.61	43.26	7.66	4
6359	0.70	7.23	0.39	0.03	0.47	0.49	0.00	38.75	0.16	0.04	0.00	0.00	0.00	94.32	25.77	46.66	0.00	11.19	13.39	8.42	4
6360	2.60	17.06	0.82	0.00	0.64	0.84	0.00	24.50	0.13	0.11	0.00	0.00	0.00	84.82	25.00	34.28	5.86	40.91	63.40	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6361	3.09	20.43	1.57	0.16	0.71	1.27	1.43	23.53	0.15	0.18	4.65	37.04	0.00	91.24	0.00	20.63	0.00	28.64	90.85	9.56	4
6362	1.89	10.47	0.97	0.63	0.74	1.47	0.00	30.69	0.18	0.20	4.18	0.00	0.00	94.91	30.42	14.39	0.00	28.06	64.65	9.32	4
6363	3.53	18.58	1.07	0.16	1.13	1.01	1.05	21.02	0.11	0.16	0.00	42.93	0.00	101.84	38.25	76.10	7.74	56.98	92.31	7.32	4
6364	2.28	12.33	0.93	2.06	0.66	0.83	0.00	28.94	0.12	0.00	0.00	0.00	0.00	102.87	20.82	45.20	0.00	27.97	38.33	8.48	4
6365	0.81	11.74	0.46	0.04	0.35	0.45	0.00	34.71	0.16	0.10	0.00	0.00	0.00	85.79	36.81	41.05	0.00	13.71	23.98	6.57	4
6366	3.29	21.72	1.49	1.38	0.75	1.04	0.00	19.17	0.09	0.07	0.00	0.00	0.00	95.10	28.73	29.76	4.84	47.92	80.37	10.18	1
6367	3.08	20.75	1.58	0.15	1.13	1.07	0.65	20.94	0.09	0.11	0.00	50.83	0.00	88.47	29.33	154.83	5.58	47.40	75.12	8.56	4
6368	2.05	10.27	0.69	1.77	0.46	0.54	0.00	32.57	0.16	0.00	0.00	0.00	0.00	91.25	22.64	20.06	0.00	20.15	37.01	6.47	4
6369	4.26	19.99	1.31	0.27	0.67	0.74	1.09	21.94	0.11	0.05	0.00	48.34	0.00	70.68	31.42	49.57	6.67	59.65	69.03	0.00	4
6370	3.01	12.76	0.83	1.44	0.64	0.80	0.00	27.78	0.15	0.17	0.00	0.00	0.00	90.01	31.12	28.37	0.00	44.62	61.58	0.00	4
6371	1.67	9.20	1.02	0.07	0.59	0.78	0.88	31.09	0.17	0.18	0.00	0.00	0.00	78.69	27.62	19.52	0.00	30.69	44.43	0.00	4
6372	2.83	12.47	0.88	0.00	0.63	0.97	0.00	29.35	0.16	0.05	0.00	0.00	0.00	105.06	45.12	19.47	0.00	42.72	48.89	0.00	4
6373	2.23	9.36	1.33	0.08	0.63	1.20	1.11	32.51	0.17	0.17	0.00	0.00	0.00	95.79	45.54	34.47	4.74	34.69	39.01	0.00	4
6374	2.11	8.65	1.02	1.90	0.58	0.82	0.00	32.46	0.18	0.00	5.24	0.00	0.00	93.70	0.00	20.56	0.00	27.65	44.31	6.45	4
6375	2.39	11.04	1.40	0.10	0.58	0.84	0.00	32.39	0.17	0.19	0.00	0.00	0.00	70.10	30.71	28.39	0.00	34.89	54.35	0.00	4
6376	2.60	10.89	0.81	0.00	0.74	1.14	0.00	30.93	0.15	0.10	0.00	0.00	0.00	114.00	29.89	18.14	5.65	15.36	46.78	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6377	2.92	12.47	0.97	0.00	1.09	1.26	0.00	28.13	0.15	0.31	0.00	0.00	0.00	88.06	38.75	21.91	0.00	18.79	40.68	0.00	4
6378	2.66	12.42	1.63	0.11	0.63	0.85	0.00	28.68	0.14	0.14	4.04	29.15	0.00	87.35	26.47	32.73	5.60	39.49	56.32	7.15	4
6379	2.60	12.75	0.85	0.00	0.71	0.98	1.19	27.18	0.13	0.17	0.00	0.00	0.00	95.01	42.07	21.71	6.38	15.86	55.15	8.73	4
6380	2.11	9.63	0.61	0.00	0.58	0.92	0.00	31.78	0.17	0.18	0.00	0.00	0.00	93.30	28.77	25.15	0.00	11.04	31.84	0.00	4
6381	2.32	10.67	0.75	0.00	0.59	0.87	0.00	31.90	0.15	0.11	0.00	0.00	0.00	121.59	37.94	13.75	0.00	12.51	31.14	8.36	4
6382	2.53	11.51	0.79	0.00	0.72	0.95	0.92	30.68	0.21	0.17	0.00	0.00	0.00	92.74	0.00	19.35	6.05	38.10	45.02	0.00	4
6383	3.07	12.82	1.63	0.11	0.68	0.86	0.81	28.67	0.14	0.18	0.00	28.44	0.00	87.46	39.46	25.57	4.93	42.77	55.41	8.54	4
6384	2.12	10.04	0.70	0.00	0.46	0.60	0.76	33.18	0.16	0.16	0.00	0.00	0.00	104.27	30.78	30.96	0.00	32.25	40.53	9.01	4
6385	2.65	11.42	1.44	0.09	0.55	0.62	1.59	30.61	0.15	0.06	5.48	21.79	0.00	93.23	0.00	32.81	4.68	37.10	46.63	0.00	4
6386	3.21	12.32	0.86	0.00	0.63	0.74	1.15	26.53	0.15	0.35	0.00	0.00	0.00	103.05	0.00	37.77	0.00	16.87	45.12	0.00	4
6387	3.45	13.68	1.06	0.11	1.39	1.13	1.04	27.27	0.13	0.10	0.00	23.94	0.00	70.53	30.78	21.18	4.89	45.12	50.06	10.14	4
6388	3.13	12.65	1.65	0.15	1.07	1.07	1.46	28.40	0.14	0.13	0.00	24.52	0.00	89.23	43.96	16.05	5.32	43.83	49.22	0.00	4
6389	1.49	7.49	0.87	0.08	0.70	0.99	1.03	36.55	0.18	0.00	0.00	0.00	0.00	103.99	23.72	19.00	0.00	20.33	35.02	0.00	4
6390	2.17	8.24	0.90	5.28	0.42	0.44	0.00	29.77	0.16	0.00	0.00	0.00	0.00	83.64	21.85	28.84	5.44	25.09	36.83	0.00	4
6391	1.60	8.50	1.15	0.07	0.47	0.48	0.00	33.70	0.15	0.05	0.00	22.84	0.00	91.88	28.00	35.37	19.79	26.40	42.74	6.15	4
6392	1.82	6.38	1.14	2.75	0.52	0.47	0.85	30.47	0.15	0.00	0.00	0.00	0.00	93.47	32.51	31.22	0.00	33.58	37.96	6.59	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6393	2.72	11.92	1.67	0.43	0.66	0.71	0.97	28.21	0.13	0.00	0.00	0.00	0.00	83.91	26.00	22.09	20.46	45.68	56.22	7.73	4
6394	1.55	5.82	0.81	1.67	0.65	0.76	0.00	36.51	0.20	0.00	0.00	0.00	0.00	111.94	0.00	37.00	32.29	19.88	38.46	0.00	4
6395	2.07	8.78	1.51	0.09	0.63	0.85	1.29	32.63	0.16	0.08	0.00	38.27	0.00	104.49	31.40	30.02	23.41	35.45	40.20	0.00	4
6396	1.95	7.49	1.22	1.45	0.49	0.49	0.84	33.48	0.16	0.05	0.00	0.00	0.00	92.20	0.00	19.47	23.42	30.27	27.39	0.00	4
6397	2.40	10.11	1.72	0.11	0.70	2.46	0.00	28.98	0.13	0.07	0.00	40.02	0.00	98.55	26.53	15.79	5.22	44.99	52.03	0.00	4
6398	2.84	11.94	1.58	0.50	1.15	1.14	0.00	28.97	0.13	0.10	3.60	0.00	0.00	95.60	35.67	11.07	25.32	45.92	49.24	7.68	4
6399	2.63	10.75	0.89	0.00	1.06	1.01	1.47	29.76	0.13	0.15	0.00	0.00	0.00	98.99	29.59	30.41	19.76	15.68	34.38	0.00	4
6399	2.37	9.72	1.53	0.22	0.63	1.11	1.31	30.93	0.14	0.05	0.00	30.05	0.00	102.19	0.00	20.91	0.00	38.11	49.16	0.00	4
6400	2.13	9.04	1.36	0.16	0.67	0.87	0.00	33.31	0.26	0.08	4.50	0.00	0.00	92.02	21.16	54.35	29.35	36.61	28.50	0.00	4
6401	3.39	15.51	1.06	0.00	1.23	1.03	1.64	23.85	0.11	0.09	0.00	0.00	0.00	94.35	24.71	73.27	28.82	20.61	83.41	0.00	4
6402	3.04	11.07	1.79	0.12	2.05	3.20	0.00	28.33	0.14	0.09	5.76	35.40	0.00	90.55	21.79	26.55	4.71	19.70	52.99	12.10	4
6403	1.78	7.13	1.29	0.06	0.54	0.61	0.00	35.71	0.16	0.09	0.00	0.00	0.00	109.11	31.56	14.47	27.20	31.24	29.82	0.00	4
6404	2.70	9.89	1.61	1.02	0.73	0.75	0.98	30.38	0.15	0.00	0.00	0.00	0.00	98.86	23.43	15.30	24.39	42.97	40.57	0.00	4
6405	0.93	4.62	0.65	0.03	0.40	0.41	0.98	39.36	0.18	0.07	4.82	0.00	0.00	90.88	21.17	19.29	20.49	17.67	21.06	0.00	4
6406	3.08	9.75	0.90	1.37	0.00	0.96	0.70	29.14	0.16	0.11	0.00	0.00	0.00	96.87	26.45	21.65	0.00	44.51	52.12	9.19	4
6407	2.20	8.85	1.42	0.07	0.53	0.60	0.00	33.33	0.16	0.14	0.00	25.71	0.00	79.82	29.04	15.06	23.71	35.47	35.47	7.09	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6408	2.64	9.38	1.66	0.09	0.76	0.89	1.15	31.79	0.15	0.28	0.00	0.00	0.00	97.58	24.34	15.89	29.76	41.34	49.85	6.56	4
6409	2.50	10.75	0.83	0.00	0.70	0.94	0.00	30.68	0.16	0.25	0.00	0.00	0.00	90.15	0.00	19.90	21.78	15.67	45.16	0.00	4
6410	2.54	9.86	0.74	0.86	0.72	0.99	0.73	31.23	0.15	0.10	0.00	0.00	0.00	67.48	34.47	18.89	19.31	14.71	32.68	8.79	4
6411	2.32	10.44	1.54	0.34	0.72	0.90	0.00	28.19	0.13	0.08	0.00	33.61	0.00	75.20	24.27	29.89	6.71	43.30	47.97	6.39	4
6412	3.69	13.99	1.32	1.12	1.30	1.10	0.00	20.74	0.10	0.09	0.00	0.00	0.00	91.79	37.39	28.20	23.57	27.38	49.86	0.00	4
6413	1.70	7.21	1.23	0.07	0.47	0.60	0.00	34.86	0.16	0.04	0.00	0.00	0.00	86.32	26.25	17.70	0.00	29.09	30.07	0.00	4
6414	3.22	12.60	1.04	0.00	1.01	1.09	0.78	25.89	0.13	0.18	0.00	0.00	0.00	105.91	34.73	16.12	25.00	22.04	47.29	0.00	4
6415	3.49	16.67	1.11	0.00	1.27	1.40	1.36	22.22	0.11	0.27	0.00	0.00	0.00	106.81	31.60	44.51	26.54	21.55	77.12	9.89	4
6416	2.47	10.05	0.74	1.11	0.68	0.99	0.00	29.62	0.15	0.20	0.00	0.00	0.00	98.75	42.83	82.64	27.49	15.73	37.78	0.00	4
6417	2.11	8.46	1.21	0.07	0.58	0.91	0.96	33.59	0.18	0.43	4.46	24.93	0.00	91.68	51.02	40.51	24.19	31.45	47.45	7.34	4
6418	1.90	6.89	0.56	0.00	0.00	1.21	1.03	34.10	0.17	0.61	5.50	0.00	0.00	85.75	31.27	23.78	0.00	31.28	36.63	9.51	4
6419	2.14	7.90	0.66	0.00	0.56	0.90	1.17	35.12	0.18	0.61	0.00	0.00	0.00	89.22	40.54	19.53	0.00	32.23	35.48	0.00	4
6420	2.18	7.20	0.52	1.58	1.19	1.45	0.00	33.80	0.17	0.34	5.14	0.00	0.00	92.32	34.91	14.08	25.62	10.13	34.33	8.49	4
6421	2.70	10.64	0.96	0.00	0.67	1.05	0.70	29.37	0.14	0.39	0.00	0.00	0.00	96.02	34.74	13.77	29.72	18.99	34.93	0.00	4
6422	2.53	8.59	1.32	1.82	0.60	0.96	0.00	31.45	0.17	0.22	0.00	0.00	0.00	79.44	27.25	16.60	26.16	37.69	37.64	0.00	4
6423	2.95	12.15	0.92	0.00	0.67	1.02	0.00	28.64	0.14	0.26	0.00	0.00	0.00	97.44	25.78	29.44	25.02	19.91	39.18	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6424	2.02	8.18	1.35	0.08	0.75	1.18	0.00	32.88	0.17	0.36	5.00	0.00	0.00	98.64	21.79	18.04	35.90	37.04	34.37	0.00	4
6425	2.94	11.93	0.96	0.00	1.14	1.47	0.00	29.16	0.15	0.39	0.00	0.00	0.00	95.26	0.00	14.55	0.00	46.46	48.97	0.00	4
6426	0.50	3.32	0.17	0.00	0.45	0.73	0.00	41.06	0.22	0.37	0.00	0.00	0.00	72.62	0.00	15.80	0.00	13.27	12.72	0.00	4
6427	1.05	4.81	0.28	0.00	1.02	1.17	0.93	39.42	0.22	1.02	0.00	0.00	0.00	84.22	35.00	14.59	38.33	16.92	26.03	0.00	4
6428	2.26	7.93	1.29	0.29	1.07	1.30	1.09	33.96	0.18	0.40	0.00	0.00	0.00	106.15	0.00	25.35	35.27	31.79	39.73	7.84	4
6429	1.69	7.05	0.44	0.00	0.59	0.98	0.00	36.18	0.20	0.35	0.00	0.00	0.00	98.32	0.00	0.00	0.00	27.55	30.10	0.00	4
6430	2.17	9.36	1.36	0.38	0.69	1.14	0.82	31.53	0.18	0.38	0.00	0.00	0.00	90.38	0.00	20.04	31.90	37.22	46.18	7.22	4
6431	2.88	12.06	0.82	0.00	1.02	1.23	0.90	30.40	0.16	0.41	0.00	0.00	0.00	79.64	0.00	28.24	28.37	16.62	48.35	0.00	4
6432	2.26	10.12	0.71	0.00	0.75	1.31	0.00	31.74	0.19	0.39	0.00	0.00	0.00	91.54	30.70	0.00	32.78	15.04	44.55	0.00	4
6433	3.17	13.31	1.78	0.12	1.12	1.39	1.42	27.42	0.15	0.43	0.00	39.46	0.00	97.35	34.35	13.06	26.07	19.39	63.87	7.40	4
6434	1.91	8.03	0.53	1.29	0.67	1.11	0.00	33.80	0.20	0.23	0.00	0.00	0.00	89.24	31.37	19.28	27.73	11.38	36.10	0.00	4
6435	3.14	10.56	1.81	2.01	0.77	0.89	1.43	24.87	0.14	0.00	0.00	0.00	0.00	94.84	20.49	30.09	28.75	20.99	56.36	7.05	4
6436	2.01	8.97	0.62	0.00	1.06	1.40	0.92	33.44	0.17	0.49	0.00	0.00	0.00	106.44	32.10	27.63	0.00	12.66	34.62	0.00	4
6437	3.79	13.85	1.20	0.00	1.77	2.10	2.01	24.63	0.12	0.42	0.00	0.00	0.00	100.88	32.61	34.43	0.00	22.66	46.19	10.58	4
6438	2.40	9.58	0.61	1.24	0.59	0.94	0.00	31.69	0.16	0.28	0.00	0.00	0.00	97.39	28.12	22.55	34.58	13.12	37.44	0.00	4
6439	2.62	14.41	0.80	0.00	0.51	0.74	0.00	25.90	0.12	0.24	0.00	0.00	0.00	92.04	31.90	55.37	19.65	18.19	33.72	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6440	1.74	9.74	0.48	0.86	0.48	0.75	0.00	33.88	0.17	0.42	0.00	0.00	0.00	85.84	0.00	42.95	39.67	10.02	30.88	0.00	4
6441	0.61	5.92	0.13	0.00	0.49	1.00	0.00	40.60	0.22	0.74	0.00	0.00	0.00	104.85	29.28	27.65	0.00	10.48	0.00	0.00	4
6442	1.65	7.68	0.15	1.66	0.29	0.43	0.82	36.37	0.16	0.00	0.00	0.00	0.00	90.08	0.00	0.00	0.00	10.74	15.07	0.00	4
6443	1.51	11.63	0.88	0.05	0.49	0.82	0.00	32.62	0.12	0.17	0.00	0.00	0.00	89.10	0.00	16.72	27.84	24.47	33.82	6.16	4
6444	1.59	8.25	0.03	2.29	0.20	0.27	0.93	37.94	0.13	0.00	0.00	0.00	0.00	72.32	0.00	0.00	0.00	5.01	16.52	0.00	4
6445	0.19	6.51	0.09	0.00	0.16	0.33	0.00	41.66	0.12	0.02	0.00	0.00	0.00	88.82	0.00	0.00	0.00	3.87	18.38	0.00	5
6446	1.01	8.73	0.29	0.00	0.29	0.58	0.00	36.68	0.10	0.20	0.00	0.00	0.00	86.26	0.00	13.37	22.92	6.69	23.50	0.00	5
6447	1.60	8.00	0.50	0.00	0.38	0.65	0.00	35.51	0.11	0.48	0.00	0.00	0.00	82.19	21.89	15.58	21.94	24.02	34.20	5.07	4
6448	0.41	0.92	0.08	3.53	0.05	0.10	0.00	42.85	0.17	0.00	0.00	0.00	0.00	92.28	0.00	17.62	45.08	3.43	0.00	0.00	4
6449	0.13	1.30	0.00	0.37	0.08	0.22	0.00	45.58	0.04	0.00	0.00	0.00	0.00	91.43	0.00	0.00	0.00	0.00	0.00	0.00	5
6450	0.69	2.59	0.03	0.92	0.18	0.23	1.11	40.94	0.09	0.00	0.00	0.00	0.00	89.00	30.95	0.00	0.00	4.84	0.00	0.00	5
6451	0.26	1.28	0.00	0.00	0.08	0.20	1.30	45.62	0.12	0.00	0.00	0.00	0.00	83.51	0.00	13.70	22.71	0.00	0.00	0.00	5
6452	0.31	1.98	0.19	0.33	0.29	0.67	0.00	42.65	0.06	0.00	0.00	0.00	0.00	101.81	0.00	12.60	0.00	5.03	8.37	0.00	5
6453	0.29	1.46	0.01	0.35	0.09	0.26	0.00	44.99	0.21	0.00	0.00	0.00	0.00	87.20	0.00	13.84	45.77	4.87	0.00	0.00	5
6454	0.66	2.37	0.26	0.29	0.17	0.35	0.00	43.03	0.04	0.00	0.00	0.00	0.00	96.27	0.00	15.63	0.00	7.24	7.52	0.00	5
6455	0.23	0.62	0.00	0.00	0.14	0.08	0.00	45.54	0.05	0.00	0.00	0.00	0.00	82.18	0.00	0.00	0.00	0.00	0.00	0.00	5
6456	0.51	3.41	0.09	0.00	1.37	0.40	6.55	32.29	0.11	0.00	0.00	0.00	0.00	97.23	0.00	22.08	23.44	7.47	16.67	0.00	4
6457	0.17	1.12	0.00	0.33	0.05	0.13	0.00	45.63	0.05	0.00	0.00	0.00	0.00	74.33	0.00	0.00	20.69	0.00	0.00	0.00	5

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
6458	0.48	4.85	0.11	0.00	0.27	0.50	0.00	40.61	0.05	0.05	0.00	0.00	0.00	87.50	0.00	19.93	0.00	6.57	9.19	0.00	5
6459	0.55	3.08	0.37	0.34	0.31	0.25	0.00	40.85	0.06	0.02	0.00	0.00	0.00	92.51	0.00	27.63	11.83	10.24	15.06	4.91	5
6460	0.66	1.67	0.26	0.48	0.39	0.42	1.29	43.13	0.09	0.00	0.00	0.00	0.00	103.63	0.00	10.92	0.00	11.07	25.10	0.00	5
6461	1.97	8.59	0.57	0.00	0.71	1.49	0.82	33.11	0.05	0.43	0.00	0.00	0.00	99.96	0.00	17.76	0.00	10.35	42.52	9.14	4
6462	3.19	10.66	1.63	2.37	1.13	1.26	0.76	26.19	0.05	0.27	0.00	0.00	0.00	96.32	0.00	15.94	30.41	18.93	79.23	10.42	4
6463	0.70	6.31	0.35	0.02	0.37	0.51	0.93	39.62	0.10	0.00	0.00	0.00	0.00	93.64	0.00	12.16	25.36	9.10	13.79	0.00	5
6464	0.49	2.22	0.04	0.38	0.13	0.08	1.08	44.36	0.09	0.00	0.00	0.00	0.00	92.09	0.00	17.59	19.74	2.87	0.00	7.97	5
6465	0.38	5.22	0.03	0.00	0.14	0.23	0.00	41.19	0.08	0.00	0.00	0.00	0.00	104.51	0.00	16.26	0.00	4.55	0.00	0.00	5
6466	3.21	23.81	1.12	0.16	1.01	2.66	0.00	13.64	0.04	0.21	0.00	38.37	8.83	74.69	19.24	34.18	11.06	22.01	115.34	10.30	1
6467	5.01	36.77	1.60	0.25	1.37	1.34	1.19	4.67	0.04	0.00	0.00	56.41	12.84	81.79	26.92	50.52	11.31	23.21	139.50	12.39	1
6468	1.81	2.86	0.08	4.00	0.07	0.04	0.00	39.39	0.06	0.00	0.00	0.00	0.00	87.83	0.00	0.00	0.00	3.01	0.00	0.00	4
6469	0.00	1.49	0.05	0.00	0.16	0.08	0.00	45.19	0.11	0.00	0.00	0.00	0.00	92.26	22.66	11.34	19.18	3.92	0.00	0.00	5
6470	0.41	3.27	0.09	1.29	0.16	0.10	0.00	42.29	0.09	0.00	0.00	0.00	0.00	111.14	0.00	14.52	0.00	4.98	0.00	0.00	4
6471	0.16	2.84	0.05	0.00	0.21	0.19	0.00	42.23	0.09	0.00	0.00	0.00	0.00	89.26	0.00	0.00	0.00	5.39	14.25	0.00	5
6472	1.04	4.26	0.11	0.99	0.44	0.29	1.09	40.05	0.08	0.09	0.00	0.00	0.00	80.79	0.00	0.00	18.83	17.55	47.74	0.00	5
6473	0.29	4.76	0.00	0.33	0.10	0.20	0.00	44.42	0.08	0.00	0.00	0.00	0.00	93.12	0.00	19.66	0.00	3.41	0.00	0.00	5
6474	0.17	1.75	0.05	0.06	0.11	0.10	0.00	45.99	0.08	0.00	0.00	0.00	0.00	90.41	0.00	13.70	0.00	2.68	9.75	0.00	5

Appendix F. XRF results of major (wt.%) and trace elements (ppm) for the Farley core, Washington. (OH).

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7782.0	2.12	5.48	0.38	0.00	1.19	0.42	0.75	38.61	0.13	0.00	0.00	0.00	0.00	0.00	0.00	25.78	16.85	9.10	20.91	0.00	5
7782.6	7.30	23.70	2.52	0.44	4.36	1.58	0.69	4.82	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.66	135.43	0.00	3
7783.0	1.04	2.62	0.11	0.00	0.00	0.66	0.00	44.49	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7783.6	4.12	11.97	1.39	0.00	3.66	0.92	0.67	19.92	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.77	104.86	0.00	3
7784.0	8.60	26.01	2.60	0.46	4.26	2.15	0.90	4.83	0.03	0.00	0.00	0.00	0.00	0.00	0.00	72.09	0.00	56.94	149.79	27.11	3
7784.6	1.31	3.61	0.14	0.00	0.00	0.31	0.61	42.60	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7785.0	1.74	4.91	0.48	0.00	1.27	0.45	0.00	38.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	15.75	15.13	8.03	18.00	0.00	5
7785.6	9.00	25.89	2.67	0.00	4.72	1.28	1.26	4.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	101.49	0.00	58.32	142.14	17.37	3
7786.1	8.04	23.07	2.30	0.00	3.96	1.92	0.76	10.22	0.06	0.00	0.00	0.00	0.00	0.00	0.00	89.96	22.99	50.58	108.32	23.34	3
7787.1	7.16	22.07	2.48	0.00	4.20	2.05	0.68	8.65	0.04	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.69	111.39	0.00	3
7787.3	6.72	21.79	2.47	0.41	4.10	1.07	0.69	7.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	79.30	0.00	51.20	121.95	0.00	3
7787.6	9.42	26.97	2.78	0.50	4.54	2.53	1.31	5.54	0.02	0.00	0.00	0.00	0.00	0.00	0.00	81.95	0.00	61.22	128.43	24.77	3
7788.0	6.35	18.39	2.41	0.00	3.96	1.83	0.81	10.65	0.06	0.00	0.00	0.00	14.69	0.00	77.23	89.58	15.10	53.47	116.28	26.48	1
7788.6	9.88	25.56	3.08	0.00	4.26	2.93	1.14	3.64	0.02	0.00	0.00	0.00	7.36	0.00	51.09	192.48	29.26	64.75	182.53	32.39	1
7789.0	6.08	18.75	2.35	0.00	4.09	1.21	0.70	11.70	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.96	106.42	0.00	3
7789.6	8.70	26.90	3.01	0.51	4.66	2.26	1.35	4.48	0.03	0.00	0.00	0.00	0.00	68.59	0.00	76.55	16.69	56.13	126.72	27.58	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7790.0	9.12	25.93	2.79	0.51	4.66	2.14	1.35	4.87	0.03	0.00	0.00	0.00	0.00	84.71	30.86	79.41	0.00	58.28	131.08	27.77	3
7790.6	8.80	25.73	2.75	0.00	4.21	1.79	0.91	5.35	0.03	0.00	0.00	0.00	0.00	69.97	0.00	72.50	13.66	60.51	121.36	23.87	3
7791.0	8.99	26.70	2.44	0.44	4.20	1.43	0.86	6.45	0.03	0.00	0.00	0.00	0.00	0.00	0.00	70.61	0.00	54.46	129.59	20.07	3
7791.6	10.40	27.10	2.99	0.45	4.43	1.19	1.68	4.79	0.02	0.00	0.00	0.00	0.00	0.00	0.00	73.29	0.00	61.91	120.39	12.59	3
7792.0	10.08	27.09	2.91	0.00	4.66	1.48	1.30	4.43	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.72	131.44	0.00	3
7792.6	8.30	26.50	2.14	0.00	4.43	2.01	1.12	6.79	0.03	0.00	0.00	0.00	0.00	70.67	0.00	87.92	16.17	47.04	139.00	21.01	3
7793.0	6.81	19.67	2.02	0.00	3.69	2.06	1.31	13.28	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.40	92.62	0.00	3
7793.6	7.37	22.80	2.75	0.51	4.72	2.49	0.42	3.79	0.02	0.00	0.00	0.00	0.00	0.00	0.00	82.66	24.27	58.38	123.25	25.58	3
7794.0	8.07	20.80	2.03	0.00	4.51	2.63	0.96	13.78	0.05	0.00	0.00	0.00	0.00	0.00	0.00	76.91	29.90	49.53	103.30	21.99	3
7794.6	8.89	25.93	2.86	0.51	4.78	1.94	1.17	4.31	0.03	0.00	0.00	0.00	0.00	0.00	0.00	84.74	19.63	59.21	121.96	13.38	3
7795.0	8.95	25.03	2.60	0.00	4.12	1.35	1.04	6.62	0.04	0.00	0.00	0.00	0.00	0.00	0.00	65.69	19.03	57.77	128.18	15.39	3
7795.6	5.97	18.94	2.56	0.00	5.41	3.32	0.96	7.99	0.03	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.00	124.91	0.00	3
7796.0	8.93	25.39	2.67	0.42	4.52	2.84	1.06	4.37	0.03	0.00	0.00	0.00	0.00	76.91	24.76	106.02	14.37	59.90	132.46	24.45	3
7796.6	5.66	15.76	1.48	0.00	3.49	1.65	1.33	19.01	0.07	0.00	0.00	0.00	0.00	0.00	0.00	241.39	0.00	41.64	94.12	0.00	3
7797.0	8.97	26.04	2.66	0.48	4.44	2.62	1.01	5.20	0.03	0.04	0.00	0.00	0.00	0.00	45.85	80.70	0.00	57.30	123.58	28.20	3
7797.6	6.66	21.54	2.85	0.49	4.77	2.12	0.80	4.26	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.90	126.03	0.00	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7798.0	7.56	21.68	2.49	0.00	4.40	2.10	0.60	9.10	0.04	0.06	0.00	0.00	0.00	0.00	0.00	78.97	0.00	50.69	122.38	30.91	3
7798.6	1.51	4.37	0.27	0.00	1.10	0.39	0.00	41.11	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7799.0	7.03	20.30	2.53	0.00	3.99	1.15	0.94	9.41	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.50	101.76	0.00	3
7799.6	8.94	25.62	2.67	0.44	4.31	2.39	1.17	5.94	0.03	0.00	0.00	0.00	0.00	0.00	0.00	93.41	0.00	58.44	125.64	27.59	3
7800.0	7.45	21.73	2.41	0.00	4.12	2.39	0.00	4.64	0.03	0.00	0.00	0.00	0.00	0.00	0.00	75.04	0.00	69.23	115.00	10.64	3
7800.6	3.60	9.77	0.55	0.00	3.14	1.18	0.78	31.09	0.07	0.00	0.00	0.00	0.00	0.00	0.00	80.24	0.00	33.14	72.78	17.68	3
7801.0	9.39	25.78	2.92	0.00	4.62	2.32	1.36	4.28	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.10	134.95	0.00	3
7802.0	9.52	25.33	2.75	0.00	2.52	2.27	1.18	15.33	0.10	0.00	0.00	0.00	0.00	0.00	0.00	38.40	0.00	19.66	54.49	0.00	3
7802.6	8.17	23.44	2.69	0.00	4.08	1.00	1.16	7.15	0.04	0.00	0.00	0.00	0.00	0.00	0.00	74.29	0.00	52.63	121.84	15.23	3
7803.0	9.15	26.10	2.86	0.00	4.40	1.89	1.06	4.79	0.03	0.00	0.00	0.00	0.00	0.00	38.55	91.23	0.00	60.74	126.70	17.87	3
7803.6	6.44	21.57	2.27	0.44	3.73	1.54	0.80	9.13	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.46	147.85	0.00	3
7804.0	9.09	24.79	2.83	0.00	4.41	1.40	1.34	6.23	0.03	0.00	0.00	0.00	0.00	0.00	0.00	93.06	0.00	57.10	122.51	0.00	3
7804.6	2.63	7.16	0.61	0.00	2.01	0.81	0.92	35.52	0.10	0.00	0.00	0.00	0.00	0.00	0.00	34.82	0.00	11.58	37.50	12.38	5
7805.0	4.62	13.80	1.21	0.00	2.89	1.39	1.05	24.51	0.07	0.00	0.00	0.00	0.00	0.00	0.00	50.57	0.00	27.71	70.96	17.67	3
7805.6	8.20	23.58	2.91	0.00	4.33	0.93	0.85	5.55	0.04	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	61.76	118.91	0.00	3
7806.0	7.24	24.46	2.12	0.00	3.57	1.47	0.75	9.92	0.05	0.00	0.00	0.00	0.00	0.00	0.00	65.33	0.00	45.45	126.71	13.77	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7806.6	2.40	6.78	0.62	0.00	1.78	0.52	0.00	35.81	0.09	0.00	0.00	0.00	0.00	0.00	50.40	22.95	0.00	11.85	30.80	0.00	5
7807.0	7.54	22.75	2.59	0.00	4.27	2.10	0.94	7.18	0.04	0.03	0.00	0.00	0.00	0.00	0.00	81.52	0.00	54.21	122.65	22.08	3
7807.6	9.30	26.30	3.37	0.50	4.10	2.49	0.89	6.51	0.03	0.00	0.00	0.00	0.00	0.00	0.00	81.68	13.10	55.40	119.62	17.10	3
7808.0	9.98	26.13	2.87	0.00	4.38	1.73	1.13	6.31	0.04	0.00	0.00	0.00	0.00	0.00	0.00	82.30	0.00	58.33	119.13	22.38	3
7808.6	8.21	24.86	2.46	0.00	4.10	1.49	1.18	6.98	0.04	0.00	0.00	0.00	0.00	0.00	0.00	81.45	0.00	51.87	119.14	17.25	3
7809.0	8.85	25.54	2.79	0.00	4.46	2.23	1.10	5.21	0.03	0.00	0.00	0.00	0.00	0.00	0.00	79.25	0.00	60.55	128.82	18.29	3
7809.6	8.98	25.75	2.95	0.48	4.22	2.24	1.19	5.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.69	122.32	0.00	3
7810.0	8.65	24.62	2.74	0.00	4.50	2.99	0.89	5.45	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.52	139.04	0.00	3
7810.6	9.80	24.97	2.91	0.00	4.58	1.88	1.25	6.67	0.04	0.09	0.00	0.00	0.00	0.00	0.00	80.16	0.00	60.57	123.34	13.05	3
7811.0	9.26	25.06	2.77	0.00	4.27	2.03	1.05	6.17	0.04	0.00	0.00	0.00	0.00	0.00	0.00	73.15	0.00	58.68	117.01	10.51	3
7811.6	9.52	26.40	2.95	0.52	4.51	2.18	0.91	3.96	0.03	0.00	0.00	0.00	0.00	0.00	0.00	69.65	0.00	62.87	122.39	13.17	3
7812.0	8.32	23.25	2.65	0.00	4.04	1.73	0.91	6.95	0.04	0.00	0.00	0.00	0.00	0.00	33.06	71.38	0.00	57.52	120.12	15.57	3
7812.6	5.00	12.96	0.94	0.00	2.67	1.12	0.67	28.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	34.25	0.00	26.10	66.73	12.10	3
7813.0	4.19	11.37	0.95	0.00	2.54	0.79	0.68	28.02	0.09	0.00	0.00	0.00	0.00	0.00	0.00	56.81	0.00	24.98	55.22	9.83	3
7813.6	9.07	25.05	2.85	0.00	4.25	2.58	1.14	5.56	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.32	122.11	0.00	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7814.0	4.39	12.87	1.32	0.00	2.95	1.51	0.88	23.59	0.08	0.00	0.00	0.00	0.00	0.00	0.00	39.48	0.00	29.80	71.26	22.88	3
7814.6	1.02	2.79	0.16	0.00	1.01	0.41	0.00	43.25	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7815.0	8.16	23.93	2.68	0.47	4.47	1.92	0.89	5.64	0.03	0.00	0.00	0.00	0.00	0.00	0.00	97.10	0.00	58.70	143.25	28.95	3
7815.6	8.47	25.24	2.64	0.00	4.65	2.05	0.90	5.47	0.03	0.00	0.00	0.00	0.00	0.00	41.83	90.24	0.00	56.07	140.71	25.09	3
7816.0	9.03	25.96	2.76	0.49	4.62	1.69	1.00	4.42	0.03	0.00	0.00	0.00	0.00	87.78	0.00	78.77	23.20	59.10	145.75	17.96	3
7816.6	8.56	23.20	2.26	0.00	4.12	2.28	1.40	10.36	0.04	0.00	0.00	0.00	0.00	0.00	0.00	150.14	0.00	50.43	109.97	15.67	3
7817.0	7.15	19.88	2.49	0.00	4.61	2.07	0.71	5.48	0.03	0.00	0.00	0.00	0.00	0.00	0.00	88.87	0.00	58.41	118.49	15.56	3
7817.6	3.42	7.55	0.28	0.00	1.44	0.75	0.68	42.34	0.10	0.00	0.00	0.00	0.00	0.00	0.00	36.24	0.00	3.36	9.01	0.00	5
7818.0	9.51	25.44	3.02	0.00	4.30	1.59	0.73	4.59	0.03	0.00	0.00	0.00	0.00	0.00	0.00	78.26	0.00	61.29	132.14	10.00	3
7818.6	8.67	23.93	2.72	0.00	4.34	1.78	1.24	6.21	0.03	0.00	0.00	0.00	0.00	0.00	0.00	78.75	0.00	57.14	135.54	24.42	3
7819.0	6.04	14.64	0.60	0.00	1.76	1.33	1.46	36.52	0.13	0.00	0.00	0.00	0.00	0.00	0.00	20.88	0.00	11.22	22.61	14.89	5
7819.6	9.47	25.13	2.74	0.48	4.55	1.13	1.47	5.69	0.03	0.00	0.00	0.00	0.00	0.00	0.00	83.41	0.00	58.60	132.61	21.26	3
7820.0	7.87	21.82	2.43	0.00	3.97	1.70	0.99	11.78	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.76	109.44	0.00	3
7820.6	8.75	24.62	2.59	0.00	4.22	1.72	1.06	7.50	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.82	130.65	0.00	3
7821.0	7.83	23.38	2.62	0.00	4.31	1.89	0.93	6.60	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.24	134.67	0.00	3
7821.6	10.27	25.84	2.89	0.00	4.93	2.78	1.07	6.26	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	63.11	113.70	0.00	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7822.0	7.17	22.06	2.45	0.00	4.04	2.18	0.69	7.65	0.04	0.00	0.00	0.00	0.00	0.00	0.00	72.45	16.82	53.12	109.77	18.02	3
7823.0	8.44	22.86	2.38	0.00	4.20	1.77	1.04	9.93	0.04	0.00	0.00	0.00	0.00	0.00	28.07	72.20	0.00	53.11	114.02	26.96	3
7823.6	8.22	22.95	2.30	0.00	3.88	1.37	1.00	10.86	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.64	125.42	0.00	3
7824.0	2.54	6.78	0.69	0.00	0.92	0.28	0.60	37.13	0.03	0.00	0.00	0.00	0.00	0.00	0.00	17.29	0.00	12.56	28.98	0.00	5
7824.6	9.53	24.43	2.74	0.00	3.96	1.69	1.35	8.51	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.69	130.37	0.00	3
7825.0	2.96	8.15	0.53	0.00	1.77	0.44	0.54	37.64	0.09	0.00	0.00	0.00	0.00	0.00	0.00	19.81	15.96	15.16	36.31	11.67	5
7826.0	8.66	24.24	2.75	0.00	4.43	2.31	1.53	6.42	0.03	0.00	0.00	0.00	0.00	0.00	0.00	262.82	0.00	57.50	110.47	0.00	3
7826.6	9.61	24.95	2.88	0.00	3.97	1.00	1.22	6.63	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	58.25	121.90	0.00	3
7827.0	7.62	18.88	2.17	0.00	3.34	1.46	1.06	15.09	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.41	113.89	0.00	3
7827.6	4.42	13.59	2.28	0.00	3.49	1.00	1.03	13.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.10	110.71	0.00	3
7828.0	6.91	19.87	2.24	0.00	4.00	1.77	1.35	10.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	69.91	0.00	57.84	111.47	17.69	3
7828.6	7.66	20.89	2.17	0.00	3.50	1.46	1.12	13.32	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.52	109.74	0.00	3
7829.0	7.34	21.66	2.43	0.00	3.90	1.49	0.84	9.67	0.05	0.00	0.00	0.00	0.00	99.31	0.00	76.45	0.00	50.12	120.48	26.23	3
7829.6	8.13	22.99	2.68	0.00	3.99	1.64	1.24	7.40	0.04	0.00	0.00	0.00	0.00	0.00	0.00	77.47	0.00	54.98	117.89	22.60	3
7830.0	5.11	14.26	1.34	0.00	2.99	0.70	0.72	23.62	0.05	0.00	0.00	0.00	0.00	0.00	0.00	361.22	0.00	34.55	71.75	0.00	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7830.6	6.87	18.45	2.19	0.00	3.50	0.85	0.96	15.84	0.04	0.00	0.00	0.00	0.00	0.00	0.00	57.67	0.00	41.62	85.86	20.46	3
7831.0	8.10	22.33	2.75	0.00	4.23	2.23	0.98	7.52	0.03	0.00	0.00	0.00	0.00	0.00	0.00	70.05	0.00	55.46	123.86	26.94	3
7831.6	7.48	20.94	2.22	0.00	3.94	2.03	0.81	11.54	0.05	0.00	0.00	0.00	0.00	0.00	0.00	70.10	0.00	47.98	103.74	26.10	3
7832.0	8.68	23.89	2.76	0.00	4.04	2.07	1.23	7.30	0.03	0.00	0.00	0.00	0.00	0.00	0.00	80.52	0.00	56.70	115.55	34.35	3
7832.6	8.66	21.88	2.28	0.00	3.82	1.33	0.90	13.56	0.05	0.00	0.00	0.00	0.00	0.00	0.00	68.37	0.00	45.85	94.29	21.65	3
7833.0	6.83	19.36	2.19	0.00	3.75	1.59	0.65	12.31	0.05	0.00	0.00	0.00	0.00	0.00	0.00	63.36	0.00	46.20	101.58	26.89	3
7833.6	7.89	20.63	2.51	0.00	3.90	1.44	1.19	12.31	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.45	98.19	0.00	3
7834.0	8.50	22.66	2.54	0.43	4.34	1.59	1.32	8.95	0.03	0.00	0.00	0.00	0.00	73.23	0.00	72.75	0.00	55.23	109.33	22.46	3
7834.6	7.71	22.14	2.68	0.00	4.16	1.46	0.82	7.62	0.03	0.00	0.00	0.00	0.00	0.00	0.00	75.31	17.25	53.14	112.43	22.69	3
7835.0	5.40	15.12	1.65	0.00	2.81	0.78	0.95	22.27	0.05	0.00	0.00	0.00	0.00	0.00	0.00	52.07	0.00	30.54	61.30	16.45	3
7835.6	6.74	20.22	2.29	0.00	3.86	1.80	0.70	10.62	0.04	0.00	0.00	0.00	0.00	0.00	0.00	56.38	0.00	51.33	118.99	25.97	3
7836.0	8.37	22.91	2.54	0.00	3.86	1.40	0.88	9.58	0.04	0.00	0.00	0.00	0.00	0.00	0.00	70.10	0.00	51.08	112.48	17.85	3
7836.6	8.05	22.74	2.67	0.00	3.80	1.49	0.86	8.56	0.03	0.00	0.00	0.00	6.49	55.19	20.30	69.58	15.54	53.47	110.99	22.06	3
7837.0	8.26	23.09	2.68	0.00	4.10	1.87	0.86	8.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	64.15	17.54	53.97	109.21	28.28	3
7837.6	7.98	21.33	2.30	0.00	3.78	1.48	1.04	11.85	0.04	0.00	0.00	0.00	0.00	0.00	0.00	57.45	0.00	46.59	105.10	24.62	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7838.0	6.93	18.57	1.94	0.00	3.75	1.60	1.06	16.61	0.05	0.00	0.00	0.00	0.00	0.00	0.00	57.06	0.00	39.20	84.54	26.51	3
7838.6	8.13	23.57	2.52	0.00	3.77	2.31	1.15	8.16	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.44	121.39	0.00	3
7839.0	7.32	20.13	2.13	0.00	3.56	1.26	1.44	14.25	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.30	96.87	0.00	3
7839.6	8.85	23.54	2.46	0.00	3.95	1.69	1.81	9.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.90	112.28	0.00	3
7840.0	8.72	24.24	2.55	0.00	4.05	1.80	1.31	7.69	0.03	0.00	0.00	0.00	0.00	0.00	0.00	60.30	0.00	52.95	107.70	34.23	3
7840.6	4.07	13.70	2.23	0.00	3.79	1.08	0.51	13.75	0.04	0.00	0.00	0.00	0.00	0.00	0.00	67.05	0.00	49.58	103.01	25.87	3
7841.0	8.01	22.79	2.61	0.00	4.03	1.63	0.79	8.57	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.57	118.15	0.00	3
7841.6	8.46	23.53	2.70	0.00	3.94	1.56	1.00	8.14	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.03	114.11	0.00	3
7842.0	8.35	23.54	2.41	0.00	3.97	1.67	1.21	9.82	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	50.81	110.29	0.00	3
7842.0	9.24	25.63	2.68	0.00	4.04	1.71	1.34	7.25	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.25	109.13	0.00	3
7843.0	8.42	25.78	2.63	0.00	4.26	2.96	0.88	6.07	0.04	0.09	0.00	0.00	0.00	0.00	38.18	84.39	0.00	51.33	151.97	20.70	3
7843.6	9.20	24.88	2.85	0.00	4.11	1.77	1.08	7.43	0.03	0.00	0.00	0.00	0.00	0.00	0.00	85.09	0.00	54.63	110.38	26.43	3
7844.0	8.66	23.21	2.42	0.00	3.72	0.87	1.16	12.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	81.30	0.00	47.44	96.82	17.85	3
7844.6	9.10	25.60	2.75	0.00	4.05	1.35	1.07	7.26	0.03	0.00	0.00	0.00	0.00	81.77	0.00	106.17	0.00	55.87	118.02	24.63	3
7845.0	7.93	24.08	2.66	0.00	3.77	0.95	0.97	6.22	0.02	0.00	0.00	0.00	0.00	0.00	30.70	96.66	0.00	59.97	117.71	17.50	3
7845.6	8.06	23.13	2.56	0.00	3.50	1.01	0.74	9.71	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	51.90	107.88	0.00	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7845.0	9.39	25.95	2.89	0.00	3.81	1.04	1.00	6.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.40	120.22	0.00	3
7845.6	9.73	26.10	3.22	0.00	3.60	0.95	1.24	4.80	0.02	0.00	0.00	0.00	0.00	0.00	0.00	125.17	19.29	63.31	157.54	22.47	3
7846.0	8.67	25.54	2.81	0.00	3.56	1.09	0.91	6.44	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.47	137.02	0.00	3
7846.6	8.99	26.50	2.69	0.00	3.54	0.81	1.05	7.19	0.03	0.00	0.00	0.00	0.00	0.00	0.00	90.49	0.00	54.71	113.15	13.36	3
7847.0	9.16	26.08	2.69	0.43	3.88	1.67	1.19	6.72	0.03	0.00	0.00	0.00	0.00	0.00	0.00	89.62	17.17	56.65	113.19	26.06	3
7847.6	7.29	20.45	2.22	0.00	3.92	2.30	1.00	12.84	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.95	97.36	0.00	3
7848.0	9.32	25.29	2.71	0.00	4.79	2.69	0.99	7.09	0.03	0.00	0.00	0.00	0.00	105.92	0.00	90.41	15.82	54.90	106.66	36.73	3
7848.6	9.59	27.25	2.86	0.00	3.76	0.88	1.22	5.20	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.75	115.03	0.00	3
7849.0	9.57	26.32	2.70	0.00	3.60	1.16	1.53	6.39	0.03	0.00	0.00	0.00	0.00	0.00	30.59	85.15	0.00	57.59	105.49	22.98	3
7849.6	9.11	25.92	2.77	0.00	3.72	1.45	0.99	6.98	0.03	0.00	0.00	0.00	0.00	0.00	0.00	112.13	0.00	57.03	107.68	0.00	3
7850.0	8.13	24.55	2.69	0.00	3.57	0.94	0.78	7.36	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.16	102.93	0.00	3
7850.6	5.35	16.80	1.40	0.00	2.49	0.77	1.25	20.93	0.07	0.00	0.00	0.00	0.00	0.00	0.00	64.86	0.00	31.52	78.02	18.09	3
7851.0	8.79	23.54	2.31	0.00	4.05	1.88	1.15	10.78	0.04	0.00	0.00	0.00	0.00	0.00	0.00	85.37	22.59	48.98	103.83	38.89	3
7851.6	9.50	28.19	2.70	0.00	3.61	1.23	0.98	6.88	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.17	105.27	0.00	3
7852.0	7.14	22.88	2.22	0.00	3.73	1.64	0.65	10.46	0.04	0.00	0.00	0.00	0.00	82.95	39.90	83.15	0.00	46.22	128.19	36.84	3
7853.0	5.96	19.48	2.08	0.00	3.05	0.79	0.49	14.37	0.05	0.00	0.00	0.00	0.00	0.00	0.00	75.66	0.00	43.21	96.75	19.22	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7854	5.97	18.66	2.47	0.41	3.82	0.99	0.51	9.39	0.04	0.00	0.00	0.00	0.00	0.00	0.00	61.79	0.00	50.19	101.88	31.91	3
7855	6.71	21.05	2.08	0.00	3.18	1.56	1.02	13.01	0.05	0.00	0.00	0.00	10.72	0.00	0.00	57.47	0.00	41.50	107.01	26.86	3
7856	5.89	18.21	1.95	0.00	2.99	0.89	1.01	15.95	0.05	0.00	0.00	0.00	0.00	0.00	0.00	59.20	0.00	41.82	97.53	19.27	3
7857	7.47	23.88	2.44	0.00	3.33	0.94	0.82	8.75	0.03	0.00	0.00	0.00	0.00	81.09	0.00	59.69	0.00	50.72	113.71	27.32	3
7858	7.68	23.50	2.54	0.00	3.56	1.52	0.68	9.05	0.04	0.00	0.00	0.00	0.00	0.00	0.00	104.14	16.95	51.01	100.58	42.22	3
7859	1.56	5.49	0.39	0.00	1.12	0.56	0.61	38.34	0.18	0.00	3.51	0.00	0.00	0.00	0.00	24.97	29.26	10.65	19.79	0.00	5
7860	2.74	9.30	0.71	0.00	1.60	0.62	0.48	33.12	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	16.71	0.00	0.00	5
7861	1.67	5.29	0.33	0.00	1.58	1.08	0.00	40.14	0.20	0.00	0.00	0.00	0.00	0.00	0.00	25.45	20.25	7.14	22.37	8.04	5
7862	6.32	22.02	1.93	0.00	2.85	1.23	0.57	14.45	0.06	0.00	0.00	0.00	0.00	0.00	0.00	94.55	22.82	41.16	114.27	39.12	3
7863	13.58	23.13	4.93	0.00	1.90	0.64	0.59	0.21	0.00	0.00	0.00	0.00	10.72	0.00	0.00	0.00	66.88	80.07	201.24	21.36	3
7864	6.76	23.87	2.07	0.00	2.88	1.13	0.71	12.43	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	42.98	109.48	0.00	3
7865	6.42	22.50	2.10	0.00	3.11	2.57	0.47	11.39	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.69	107.45	0.00	3
7866	5.49	21.01	1.83	0.00	2.59	1.11	0.64	14.63	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	38.43	104.31	0.00	3
7867	5.68	21.69	1.84	0.00	2.28	1.00	0.67	15.07	0.05	0.00	0.00	0.00	0.00	0.00	0.00	85.84	18.70	37.38	103.59	12.65	3
7867.8	2.31	7.17	0.47	0.00	2.66	4.37	0.00	36.10	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7868	6.95	25.58	2.11	0.00	2.67	1.03	0.99	10.39	0.04	0.00	0.00	0.00	0.00	0.00	0.00	76.09	0.00	42.94	102.31	27.24	3
7869	5.91	22.27	1.89	0.00	2.72	1.99	0.50	13.77	0.05	0.00	0.00	0.00	0.00	0.00	0.00	70.09	0.00	37.87	108.04	34.42	3
7870	5.17	19.65	2.00	0.00	2.40	1.04	0.00	14.34	0.05	0.00	0.00	0.00	0.00	0.00	0.00	88.59	16.14	39.57	88.66	19.77	3
7871	4.42	18.52	1.59	0.00	2.19	3.06	0.54	16.62	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.69	90.92	0.00	3
7872	6.22	24.02	1.93	0.38	2.74	1.59	0.82	12.36	0.05	0.00	0.00	0.00	0.00	0.00	0.00	81.17	20.22	41.54	95.96	22.84	3
7873	6.41	23.79	2.07	0.00	2.90	1.50	0.84	11.27	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.77	97.07	0.00	3
7874	6.02	23.47	1.94	0.00	2.94	2.80	0.57	12.06	0.05	0.00	0.00	0.00	0.00	0.00	0.00	157.12	0.00	41.50	93.19	32.25	3
7875	5.94	20.63	1.78	0.00	2.21	1.10	0.89	16.78	0.06	0.00	0.00	0.00	0.00	0.00	0.00	64.18	0.00	35.09	87.86	18.84	3
7876	6.64	20.91	2.44	0.00	2.78	1.17	0.68	11.57	0.04	0.00	0.00	0.00	0.00	0.00	0.00	79.34	0.00	49.04	93.90	31.92	3
7878	5.83	21.47	1.95	0.00	2.92	1.62	0.99	12.24	0.04	0.00	0.00	0.00	0.00	0.00	47.09	68.87	0.00	40.85	86.67	30.26	3
7879	6.62	21.87	2.06	0.00	2.89	1.77	0.68	13.92	0.05	0.00	0.00	0.00	0.00	0.00	0.00	60.92	19.87	41.64	85.64	32.77	3
7880	6.14	21.28	1.94	0.00	2.61	1.39	0.88	15.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.42	85.65	0.00	3
7881	5.17	19.37	1.57	0.00	2.35	1.83	0.98	18.64	0.06	0.00	0.00	0.00	0.00	0.00	0.00	89.54	0.00	33.66	95.67	20.68	3
7882	6.27	22.97	2.05	0.00	2.99	1.74	0.70	11.91	0.04	0.00	0.00	0.00	0.00	0.00	28.11	128.12	14.99	42.72	98.50	35.02	3
7883	7.15	24.58	2.25	0.00	3.10	1.46	1.18	10.52	0.04	0.00	0.00	0.00	0.00	73.04	0.00	89.12	19.40	46.23	109.51	29.91	3
7884	6.02	20.62	2.30	0.44	2.86	1.49	0.61	13.18	0.04	0.00	0.00	0.00	0.00	0.00	0.00	88.16	24.96	44.23	104.29	17.57	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7885	7.48	25.82	2.27	0.00	3.15	1.62	0.61	9.44	0.04	0.00	0.00	0.00	0.00	0.00	0.00	119.15	0.00	48.90	112.61	0.00	3
7886	6.56	21.36	2.01	0.00	3.45	3.12	1.11	13.58	0.04	0.00	0.00	0.00	0.00	77.22	0.00	36.66	0.00	41.60	90.33	46.11	3
7887	5.59	22.70	1.91	0.00	2.40	0.97	0.49	13.42	0.05	0.00	0.00	0.00	0.00	0.00	0.00	78.58	0.00	40.17	96.15	19.53	3
7888	7.45	24.80	2.31	0.00	3.65	1.84	0.92	8.16	0.03	0.00	0.00	0.00	0.00	0.00	43.09	71.71	17.39	47.40	95.52	45.95	3
7889	5.74	21.80	2.11	0.00	3.26	1.68	0.72	9.40	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.17	103.57	0.00	3
7891	6.29	23.23	1.94	0.00	3.02	2.76	0.79	12.70	0.04	0.00	0.00	0.00	0.00	0.00	34.80	51.97	0.00	40.27	89.38	32.51	3
7892	5.66	20.31	1.79	0.00	2.55	1.78	0.59	15.81	0.05	0.00	0.00	0.00	0.00	0.00	45.20	80.76	0.00	37.27	89.01	20.79	3
7893	6.58	23.55	2.14	0.00	3.01	2.27	0.52	11.85	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	44.01	100.20	0.00	3
7894	6.90	24.07	1.96	0.00	2.72	1.44	0.77	12.69	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.38	98.79	0.00	3
7896	5.24	19.20	1.77	0.00	2.52	1.48	0.75	15.81	0.05	0.00	0.00	0.00	0.00	0.00	39.14	81.66	0.00	31.75	96.85	29.99	3
7897	5.85	23.47	1.84	0.00	2.52	1.93	0.64	12.88	0.04	0.00	0.00	0.00	0.00	0.00	46.22	96.86	0.00	39.23	104.25	28.17	3
7898	5.74	20.60	2.01	0.00	2.87	1.82	0.79	12.01	0.05	0.00	0.00	0.00	0.00	0.00	30.21	62.41	0.00	37.00	86.48	43.10	3
7899	5.84	21.60	1.91	0.00	2.46	1.52	1.04	15.06	0.05	0.00	0.00	0.00	0.00	0.00	42.00	62.24	0.00	37.91	95.59	18.99	3
7900	5.78	19.50	1.55	0.00	2.09	1.29	0.48	19.58	0.07	0.00	0.00	0.00	0.00	0.00	0.00	23.73	0.00	29.62	100.46	22.57	3
7902	6.94	23.25	1.97	0.00	2.93	2.37	1.43	12.66	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	36.75	102.20	0.00	3
7903	6.10	23.22	2.01	0.00	2.35	1.25	0.64	12.65	0.04	0.00	0.00	0.00	10.09	0.00	0.00	75.60	0.00	41.01	88.87	19.11	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7904	6.22	23.03	1.88	0.00	2.32	1.20	0.65	13.70	0.05	0.00	0.00	0.00	0.00	0.00	42.80	77.10	15.45	36.43	106.69	15.81	3
7905	4.75	22.60	1.62	0.00	2.59	1.72	0.40	13.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	35.52	100.27	0.00	3
7906	5.09	16.55	1.27	0.00	1.99	1.36	0.73	23.94	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.75	59.94	0.00	3
7908	4.85	19.00	1.74	0.00	2.03	1.15	0.83	17.33	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.00	82.56	0.00	3
7909.3	6.05	18.43	1.78	0.00	4.70	5.17	0.67	16.84	0.05	0.00	8.32	0.00	0.00	0.00	47.75	24.60	0.00	35.00	76.51	79.40	3
7910	6.73	22.64	2.10	0.00	2.49	1.15	0.74	12.25	0.04	0.00	0.00	0.00	0.00	0.00	36.07	49.12	0.00	41.07	90.95	28.17	3
7911	5.08	16.48	1.49	0.00	7.52	11.11	1.02	13.59	0.05	0.00	42.88	0.00	0.00	115.36	109.57	212.73	0.00	34.17	91.01	109.41	2
7912	6.71	23.42	1.86	0.00	2.85	2.52	0.77	13.52	0.05	0.00	0.00	0.00	0.00	0.00	49.02	86.27	0.00	36.60	107.67	46.13	3
7914	6.11	20.57	1.96	0.00	2.87	2.65	0.74	13.40	0.04	0.00	0.00	0.00	0.00	0.00	42.79	78.16	0.00	41.64	92.58	21.82	3
7915	5.54	19.10	1.69	0.00	2.38	1.53	0.92	17.94	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.68	91.88	0.00	3
7916	2.48	7.88	0.61	0.00	1.90	1.87	1.18	34.58	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.96	0.00	0.00	5
7917	3.56	13.28	1.50	0.00	2.06	1.26	0.64	19.13	0.07	0.00	0.00	0.00	0.00	0.00	34.24	36.35	0.00	33.06	90.70	19.12	3
7918	6.50	21.55	2.03	0.00	2.99	2.42	0.45	13.99	0.09	0.42	0.00	0.00	11.23	94.55	58.61	58.61	23.06	30.60	95.96	36.11	1
7920	6.01	19.40	1.98	0.00	3.33	5.01	0.56	15.09	0.05	0.00	0.00	0.00	0.00	74.95	41.64	27.12	0.00	39.60	69.88	45.55	3
7921	4.78	17.30	1.65	0.00	2.03	2.08	0.00	20.25	0.06	0.00	0.00	0.00	0.00	0.00	30.34	72.13	0.00	31.49	76.53	19.00	3
7922	5.92	21.04	1.94	0.00	2.48	2.86	0.62	14.92	0.05	0.00	0.00	0.00	0.00	68.22	34.47	113.69	0.00	39.26	93.04	25.33	3

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7923	5.21	17.48	1.70	0.00	1.99	1.48	0.60	17.50	0.06	0.00	0.00	0.00	0.00	68.17	43.58	342.03	0.00	33.71	98.98	15.77	3
7924	5.31	14.93	1.44	0.00	2.52	2.37	0.89	24.88	0.08	0.00	4.63	0.00	0.00	0.00	0.00	25.01	0.00	25.54	57.08	25.19	3
7926	0.70	2.14	0.05	0.00	0.00	0.37	0.00	44.33	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7927	5.06	15.71	1.55	0.00	2.45	1.43	1.37	19.77	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	31.47	71.25	0.00	3
7928	1.89	6.51	0.50	0.00	0.90	0.90	0.76	37.72	0.04	0.00	0.00	0.00	0.00	0.00	0.00	19.46	0.00	8.30	26.06	0.00	5
7930	0.40	1.18	0.00	0.00	0.28	0.15	0.00	46.66	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7931	7.52	20.73	2.27	0.00	3.52	2.18	1.11	11.12	0.03	0.42	0.00	0.00	0.00	0.00	0.00	36.90	18.12	44.78	101.47	14.16	4
7933	1.68	6.28	0.35	0.00	0.00	0.70	0.00	38.11	0.14	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7934	3.11	7.54	0.62	0.00	0.73	0.66	0.00	38.35	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.10	20.84	0.00	5
7936	1.21	3.90	0.26	0.00	0.00	0.49	0.00	41.14	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7937	6.96	20.37	2.17	0.00	2.64	1.30	0.87	14.55	0.06	0.21	0.00	0.00	0.00	0.00	0.00	92.85	0.00	43.79	98.42	0.00	3
7938	7.56	21.50	2.24	0.00	2.49	1.13	0.78	13.55	0.05	0.09	0.00	0.00	0.00	0.00	0.00	65.88	0.00	44.32	90.53	9.99	3
7939	6.21	17.73	1.91	0.00	2.39	1.12	1.00	17.85	0.06	0.13	0.00	0.00	0.00	0.00	0.00	43.78	0.00	37.99	90.92	12.73	3
7940	3.27	10.38	0.92	0.00	1.57	0.95	0.65	30.29	0.10	0.03	0.00	0.00	0.00	0.00	0.00	17.37	0.00	20.28	62.32	0.00	5
7941	2.78	8.37	0.66	0.00	0.98	0.56	0.00	35.92	0.08	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.90	36.81	0.00	5
7943	4.35	12.08	1.35	0.00	1.46	1.06	0.00	29.76	0.10	0.90	0.00	0.00	0.00	0.00	0.00	24.15	0.00	21.77	60.68	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7944	0.55	1.67	0.06	0.00	0.89	0.87	0.00	43.75	0.12	0.00	4.16	0.00	0.00	0.00	0.00	0.00	0.00	1.81	9.18	0.00	5
7945	0.53	1.62	0.07	0.00	0.48	0.65	0.00	44.64	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	0.00	0.00	5
7946	3.88	11.29	1.17	0.00	1.37	0.89	0.67	29.38	0.10	0.57	0.00	0.00	0.00	0.00	0.00	28.41	0.00	21.09	61.04	0.00	4
7947	6.42	17.95	1.81	0.00	2.25	1.36	0.88	19.63	0.08	0.55	0.00	0.00	0.00	0.00	0.00	39.10	0.00	33.55	76.23	9.68	4
7949	3.82	11.69	1.22	0.00	1.67	1.34	0.59	27.23	0.09	0.59	0.00	0.00	0.00	0.00	0.00	35.17	0.00	22.47	56.59	0.00	4
7950	5.11	14.41	1.48	0.00	2.30	2.22	1.05	21.87	0.08	0.43	0.00	0.00	0.00	0.00	0.00	32.22	0.00	29.11	75.53	0.00	4
7951	4.53	13.96	1.36	0.00	1.96	1.82	0.78	24.67	0.09	0.46	0.00	0.00	0.00	0.00	0.00	119.05	0.00	26.87	63.90	0.00	4
7952	3.43	10.98	1.02	0.00	1.70	1.56	0.00	28.39	0.10	0.35	0.00	0.00	0.00	0.00	0.00	25.40	0.00	20.40	67.17	0.00	4
7953	3.25	9.76	0.75	0.00	1.30	1.24	1.06	32.15	0.11	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.17	45.23	0.00	4
7955	5.30	16.23	1.59	0.00	2.09	2.05	0.65	23.68	0.08	0.65	0.00	0.00	0.00	0.00	0.00	47.73	0.00	28.46	67.31	11.31	4
7956	2.33	6.76	0.59	0.00	0.77	0.66	0.00	37.20	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.35	22.09	0.00	5
7957	6.92	19.50	2.80	0.00	3.33	1.26	0.50	7.93	0.03	0.00	0.00	0.00	0.00	0.00	0.00	41.84	16.32	61.25	107.58	0.00	3
7958	0.47	1.61	0.03	0.00	0.23	0.41	0.00	44.35	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7959	1.78	5.13	0.41	0.00	0.41	0.53	0.00	40.55	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.23	14.36	0.00	5
7961	0.23	1.04	0.00	0.00	0.00	0.21	0.00	45.87	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5
7962	7.19	18.87	2.22	0.00	2.41	2.16	0.77	16.96	0.05	0.48	0.00	0.00	0.00	0.00	0.00	41.54	0.00	41.14	82.03	0.00	4

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7963	0.30	1.42	0.08	0.01	0.13	0.20	0.00	46.14	0.10	0.09	0.00	0.00	0.00	82.37	0.00	13.42	0.00	4.97	0.00	0.00	5
7964	0.81	3.18	0.14	0.00	0.63	0.77	0.00	41.60	0.10	0.00	0.00	0.00	0.00	76.94	0.00	0.00	0.00	12.60	15.37	0.00	5
7965	0.41	1.32	0.00	0.00	0.15	0.32	0.00	46.30	0.08	0.00	0.00	0.00	0.00	94.41	0.00	0.00	0.00	0.00	0.00	0.00	5
7966.1	0.44	2.21	0.08	0.37	0.15	0.18	0.00	44.56	0.07	0.07	0.00	0.00	0.00	96.59	0.00	19.80	0.00	6.69	10.26	0.00	5
7967	0.24	1.69	0.09	0.33	0.14	0.26	0.00	45.61	0.10	0.00	0.00	0.00	0.00	85.61	0.00	11.83	18.97	3.92	0.00	7.41	5
7968	0.42	1.73	0.04	0.36	0.17	0.17	1.18	44.02	0.08	0.00	0.00	0.00	0.00	84.92	0.00	16.69	0.00	5.54	0.00	0.00	5
7969	0.48	2.40	0.03	0.00	0.22	0.21	0.00	45.79	0.08	0.00	0.00	0.00	0.00	102.76	0.00	13.96	0.00	0.00	0.00	0.00	5
7970	0.68	6.01	0.08	0.00	0.32	0.62	0.00	40.32	0.10	0.14	0.00	0.00	0.00	95.83	0.00	17.09	24.87	7.22	40.22	0.00	5
7971	0.89	7.01	0.21	0.00	0.33	0.25	0.00	39.69	0.08	0.00	0.00	0.00	0.00	92.04	15.65	22.60	19.53	12.82	14.92	5.26	5
7972	0.00	0.00	1.01	0.20	2.00	1.70	0.00	24.04	0.06	0.00	0.00	38.03	0.00	99.51	27.15	38.80	5.82	21.36	87.23	12.73	4
7973.3	0.54	3.91	0.02	0.00	0.20	0.69	0.00	42.58	0.08	0.04	0.00	0.00	0.00	88.80	0.00	0.00	0.00	4.35	27.36	7.64	5
7974	3.88	20.63	0.94	0.00	2.02	1.89	1.43	19.99	0.06	0.36	0.00	0.00	0.00	80.15	31.36	37.06	18.26	20.80	103.15	15.84	4
7975	0.51	3.84	0.13	0.01	0.29	0.22	0.00	43.41	0.07	0.00	0.00	0.00	0.00	83.65	0.00	13.60	0.00	3.89	18.73	0.00	5
7976	1.31	12.45	0.22	0.00	0.42	0.54	0.00	35.12	0.08	0.05	0.00	0.00	0.00	96.75	0.00	16.62	0.00	15.06	24.09	0.00	5
7977	0.60	7.64	0.23	0.02	0.22	0.21	0.00	40.09	0.09	0.00	0.00	0.00	0.00	88.86	19.12	12.28	24.07	7.86	13.16	0.00	5
7978	1.67	16.00	0.30	0.00	0.52	0.41	0.00	32.81	0.08	0.03	0.00	0.00	0.00	84.04	0.00	33.28	0.00	16.56	34.26	0.00	5

Continued

Depth (ft)	Al (wt%)	Si (wt%)	K (wt%)	Ti (wt%)	Fe (wt%)	S (wt%)	Mg (wt%)	Ca (wt%)	Sr (wt%)	P (wt%)	Mo (ppm)	V (ppm)	U(ppm)	Ni (ppm)	Cu (ppm)	Zn (ppm)	Th (ppm)	Rb(ppm)	Zr (ppm)	Pb (ppm)	Chemofacies
7979.4	0.81	4.55	0.24	0.00	0.20	0.22	0.00	43.10	0.13	0.00	0.00	0.00	0.00	82.43	0.00	22.59	20.76	8.97	8.35	0.00	5
7980	1.02	12.72	0.44	0.03	0.33	0.29	0.00	34.10	0.09	0.03	0.00	0.00	0.00	88.89	0.00	33.25	0.00	12.32	35.62	0.00	5
7981	5.37	22.83	1.79	0.29	2.44	2.65	1.40	12.51	0.06	0.43	0.00	78.64	10.98	89.32	29.93	78.14	10.65	38.01	183.22	15.54	1
7982	6.41	24.77	2.07	0.00	3.57	1.93	1.55	9.06	0.03	0.42	0.00	0.00	10.83	88.66	28.81	65.24	9.03	44.64	128.85	20.68	1
7983	0.65	9.06	0.10	0.00	0.72	1.16	0.00	35.01	0.08	0.32	0.00	0.00	0.00	85.16	0.00	14.36	0.00	10.61	30.88	8.02	4
7984	0.27	0.79	0.00	0.37	0.15	0.22	0.00	46.99	0.07	0.00	0.00	0.00	0.00	95.60	0.00	13.36	18.53	0.00	0.00	0.00	5
7985	0.62	3.11	0.05	0.00	0.23	0.38	0.00	42.66	0.10	0.00	0.00	0.00	0.00	107.98	0.00	0.00	0.00	6.62	0.00	0.00	5
7986	0.58	4.11	0.25	0.02	0.25	0.32	0.00	43.17	0.11	0.00	0.00	0.00	0.00	72.74	0.00	0.00	22.90	8.81	10.87	0.00	5
7987	0.42	4.15	0.20	0.02	0.28	0.25	0.00	42.81	0.10	0.00	0.00	0.00	0.00	96.76	0.00	0.00	26.42	6.83	13.02	0.00	5
7988	0.47	2.99	0.00	0.00	0.20	0.29	0.00	44.40	0.11	0.00	0.00	0.00	0.00	84.64	0.00	0.00	0.00	3.64	13.04	0.00	5
7988.5	8.05	27.72	2.39	0.55	3.62	1.69	1.67	4.96	0.03	0.28	0.00	158.59	0.00	94.60	0.00	77.99	11.53	52.33	159.16	8.36	1
7994.4	0.35	4.23	0.10	0.01	0.23	0.25	0.00	44.00	0.11	0.00	0.00	0.00	0.00	78.84	0.00	15.82	0.00	4.50	19.40	0.00	5
7995	0.70	6.19	0.18	0.03	0.32	0.57	0.00	41.51	0.09	0.00	0.00	0.00	0.00	94.90	0.00	22.81	19.50	7.48	35.92	0.00	5
7996	7.75	25.18	2.43	0.00	3.82	2.80	1.46	5.97	0.04	0.81	0.00	0.00	0.00	94.26	25.12	77.18	14.00	127.80	193.16	22.06	1
7997	0.81	7.65	0.21	0.04	0.28	0.58	0.00	40.78	0.10	0.08	0.00	0.00	0.00	91.23	0.00	55.45	22.61	6.19	15.41	10.42	5
7998	4.36	21.89	1.17	0.33	2.28	3.26	1.32	15.75	0.05	0.40	0.00	101.23	0.00	87.52	0.00	43.11	7.84	26.36	221.68	13.98	1

VITA

Barbara M. Kemeh graduated from Wesley Girls' High School in Cape Coast, Ghana. In August 2013, she gained admission to Kwame Nkrumah University of Science and Technology to study geological engineering. During her undergraduate degree, she worked every summer with Golden Star Resources, a gold mining company as an intern geologist. After her degree, she worked as a trainee geoscientist with Tullow Ghana Limited, an oil and gas exploration and production company. Upon completing her training, she enrolled as a graduate student in the department of geology at Stephen F. Austin State University and graduated with a Master of Science in Geology in May, 2021.

Permanent Address: House A, Plot 16, Nortey Ababio Street, Roman Ridge, Accra-Ghana.

Style Manual: Ohio Geological Society

This thesis was typed by Barbara M. Kemeh