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People and Climate: Holocene Sediment Records of Environmental Change in Middle Egypt: Fieldwork Report and Initial Results

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Contents

Introduction

The aim of this project is to reveal more about the history of Lake Qarun through a multi-disciplinary environmental study. This approach primarily concerns the examination of sediment records, but also includes collection of data from archaeological sites in the Faiyum. The sedimentary history of Lake Qarun will be compared with (i) independent palaeoclimate records for the East African Highlands and the eastern Mediterranean; (ii) local evidence (including Nile alluvial and palaeo-shoreline sequences and Holocene playa deposits); and (iii) the cultural history of the Faiyum. This report describes the fieldwork performed to obtain long sediment cores for palaeolimnological analysis and presents initial results from those cores. Results will be used to construct a Geographical Information System (GIS).

Lake Qarun is situated in the northern part of the Faiyum depression, Egypt (Figure 1). The present lake is a shrunken remnant of an earlier lake that occupied a large part of the Faiyum depression until c. 2.3 KY BP, as evidenced by ancient beach deposits (Figure 2) described by Caton-Thompson & Gardner (1929). Archaeological data suggest that the Faiyum was a centre for human settlements during most of the Holocene (Caton-Thompson & Gardener, 1934). These data, together with historical records, indicate that the region developed as a centre for Egyptian civilisation from the mid-Holocene. Hydro-engineering works carried out by pharaohs of the first dynasty are well-documented. These works altered and controlled the flow of water from the Nile into the lake over 4,000 years ago (Butzer, 1976). There is also much geoarchaeological and sedimentary evidence for dramatic fluctuations in lake level during the late Holocene (Caton-Thompson & Gardener, 1929; Hassan, 1986). These lake level shifts were also partly associated with variations in Nile flood levels. Climate change and flood height variations have been responsible for documented changes in the political structure of Egyptian civilisation (Hassan, 1997). Around 2.3 KY BP, the level of water in the lake fell towards its current level. This reduction was probably due to a decline in the intensity of Nile floods, combined with land reclamation projects (Hassan, 1986). The long historical record of human activity in the Faiyum makes Lake Qarun a potentially important site in aiding our understanding of how human activities impact lacustrine environments and vise versa.

The ancestral lake contained fresh water, as evidenced by the presence of non-terrestrial deposits containing freshwater snails, fish and diatoms (Caton-Thompson, 1929; Aleem & Manguin, 1951; Hassan, 1986). The present lake is strongly brackish, and is fed by drainage and irrigation waters. Diatom assemblages indicate salinity fluctuations through the Holocene with salinity increasing towards the present day (Zalat, 1995; Flower et al., 2001). Saline diatom and ostracod taxa are currently present in the lake (Hawkes, 1999), suggesting that the most saline conditions exist today.

Background

Several short cores were taken from Lake Qarun prior to this fieldwork. A rod-operated piston corer was used in 1997 to collect a 107cm sediment core from the lake as part of the CASSARINA project by one of the authors (RF). A micropalaeontological investigation of this core was carried out at UCL (Hawkes, 1999). The microfossil assemblage found in this core consisted of a mono-specific ostracod assemblage and several species of benthic foraminifera. The composition of the species assemblages confirmed that the lake water was saline during deposition of the core sediment, with the most saline conditions existing at the top of the core. Currently, Lake Qarun brine is of the type Na-(Mg)-Cl-(SO_4). Compared to seawater, Lake Qarun's brine has a high Sr concentration and a high SO_4/Cl weight ratio (Rasmy & Estefan, 1983). Previously, pollen and sediment analyses of two short (88cm and 81cm) cores from Lake Qarun (Mehringer et al., 1979) provided evidence for Nile floods, lake level changes, and agricultural developments for approximately the last 300 years.

Fieldwork Objectives

The primary fieldwork objective was to obtain sediment cores of sufficient length to provide a representative sample of Holocene sediment deposition for Lake Qarun. Based on data acquired during previous fieldwork, collection of several cores from the deepest part of the lake was planned. It was determined that the greatest likelihood of recovering a continuous sequence of Holocene sediment would be achieved by coring at the deepest part of the present lake.

Additionally, a thorough modern sampling program was planned in order to characterise the influences on lake water chemistry. To determine the influences on the isotopic composition of lake water, it is necessary to determine the isotopic composition of water entering the Faiyum via the Bahr Yusef, as well as that of the water in the irrigation network, along with bedrock, soil, terrestrial and aquatic vegetation. Representative samples were to be collected in the Faiyum. An areal record of water input to the lake was planned in order to establish influences on the trace-element, oxygen isotope composition of the lake water, and carbon isotope composition of total dissolved inorganic carbon (TDIC). Water samples were to be taken from the Bahr Yusef and from several large and small drains, in addition to a thorough sampling program within the lake.

Dates

3/4/03	Fieldwork team arrived in Alexandria to pick-up coring equipment from customs.
3/4/03 - 9/4/03	Negotiated permission for entry of the coring equipment into Egypt via Alexandrian customs.

10/4/03	Coring equipment extracted from customs. Fieldwork team travelled to the Faiyum.
11/4/03	Coring platform assembled. Attempt to tow coring platform to coring location prevented by strong winds.
12/4/03	Towed platform coring to coring location 1 (N29.48050, E030.59722) (Figure 1). Began to extract cores from the lake-bed.
13/4/03	Continued extraction of sediment cores. Encountered hard sediment at 7.5m depth below sediment-water interface, which posed problems for extraction of cores. Conducted areal sampling of Lake Qarun. Surface sediment samples and surface water samples collected. Extruded core QARU 2/1, and sub-sampled the core, storing 2cm sections in labelled Whirlpac bags.
14/4/03	Completed extraction of two 8m overlapping cores from Coring Location 1 and moved the coring platform to Coring Location 2 (N29.49668, E030.61589) (Figure 1). Began to extract core. Extruded core QARU 3/3 and sub-sampled, storing 2cm sections in labelled Whirlpac bags.
15/4/03	Completed extraction of one 8m core, using the continuous drive method, from Location 2. Towed coring platform to several locations in order to obtain gravity cores (Figure 1). Returned coring platform to shore for dismantling. Extruded and sub-sampled core QARU 4/5, stored 2cm sub-samples in labelled WhirlPac bags.
16/4/03	Completed dismantling and boxing of coring equipment. Took water samples from El Bats Drain and Bahr Yusef canal.

Methodology

The location of all samples and cores was established with the use of a Garmin GPS.

Sediment Coring

Long sediment cores were obtained using a percussion piston corer located on a moored, floating platform (Figure 3). Cores of 2m and 3m were taken as appropriate for core depth and sediment type (Figure 4). Short cores were obtained using a gravity corer, operated from the same platform. All cores were collected and transported in clear, 6cm-diameter, plastic tubes.[1]

[1] Photographs of sediment can be viewed at http://ecrc.geog.ucl.ac.uk/qarun/

Coring Strategies

A distinct coring strategy was applied to each coring location.

- On 13 April 2003, the platform was moved to Coring Location 1 (N. 29.48050, E. 30.59722) (Figure 1). From this position two parallel, overlapping cores were collected, QARU 2 and 3 (Figures 1 & 4; Appendix I). Under this strategy, each drive of a core began at the depth at which the last drive finished. Having extracted the first core, a second core was then taken. Each drive of the second core began close to the mid-point of each of the drives of the previous core. In this way, stratigraphic problems associated with the beginning and end of a drive are negated by the collection of an overlapping section, ensuring a complete sediment record for all depths.

  The sections of QARU 2 went from 0.16m below the sediment/water interface to 1.46m in depth (QARU 2/1), 0.41m to 2.99m (QARU 2/2), 3.14m to 6.0m (QARU 2/3), and 6.06m to 8.26m (QARU 2/4). The sections of QARU 3 went from 1.35m to 4.27m (QARU 3/1), 4.32m to 6.89m (QARU 3/2), and 6.38m to 8.22m (QARU 3/3).
- On 14 April 2003, we moved the platform to Coring Location 2[2] (N. 29.49668, E. 30.61589), which was approximately 1km east of Coring Location 1 (Figure 1). In this position, we collected one core, QARU 4. Overlapping drives were taken during the collection of QARU 4. Under this strategy, each drive began 50cm above the point at which the previous drive ended. In this way, the disturbed sediment at the top and bottom of each drive were duplicated to ensure collection of a complete sediment record for all depths in the core.

  The sections of QARU 4 went from the surface to 1.26m (QARU 4/1), 0.3m to 3.1m (QARU 4/2), 2.8m to 5.7m (QARU 4/3), 5.3m to 8.2m (QARU 4/4), and 8.0m to 9.02m (QARU 4/5).

In addition to the long cores, three gravity cores were collected from Lake Qarun (Figure 1; Appendix II). The surface of two of these cores (QARU 7 and 8) were encrusted with calcareous worm tubes (Figure 5). The microfossils of these cores are currently being studied by one of the authors (R.A.). Initial results indicate that over 10 species of benthic foraminifera are present in Lake Qarun's surficial sediments. Species found in the gravity cores include:

- *Ammonia tepida* (very abundant);
- Miliolids (very abundant and diverse), including species such as *Quinqueloculina poeyana* (with no striations on its surface), *Quiqueloculina* sp. (with striations on its surface), *Quinqueloculina stalkeri*, *Miliolinella dilatata*, and *Pseudotriloculina* sp.;
- *Brizalina striatula* (with striations);
- *Brizalina hastata* (with no striations);
- *Elphidium incertum*;
- *Buliminella elegantissima*;

[2] The strategy to move to Location 2 was to ascertain whether there were local variations in the sediment facies. However, initial observations suggest that the sediment facies at both locations were the same.

- *Textularia porrecta*; and
- *Rosalina* sp.

Spatial Survey

Water

Water samples for laboratory analyses were collected in acid-washed, polyethylene bottles, which were sealed with electrical tape. Water samples for cation and oxygen isotope analysis were collected in 60ml bottles. Samples for the isotopic analysis of dissolved inorganic carbon (DIC) were collected in 100ml bottles. Approximately 15ml of alkaline saturated $BaCl_2$ solution was added to the last of these samples in order to precipitate the DIC as $BaCO_3$ for carbon isotope analysis. The alkaline saturated $BaCl_2$ solution was produced by dissolution of 500g $BaCl_2.2H_2O$ and 35g NaOH in 800ml deionised water.

Sediment

Using an Ekman Grab, surface sediment samples were collected from three north/south transects across the lake (Figure 1). When lowered to the lakebed, the Ekman Grab collects a 15cm^2 section of surface sediment. The contents of the grab were transferred to a large Whirlpac bag, to which preservative was added. The bag was then sealed, labelled, and taken back to the laboratory for processing.

There were differences in the sediment samples obtained between one part of the lake and another (Appendix III). All samples taken from the western-most transect were soft and fine-grained sediment with no macrofauna, whereas samples taken from the eastern-most transect were either worm tubes with little sediment; no sediment recovered because the substrate was too hard; or soft and fine-grained sediment with numerous bivalves.

Much of the modern sampling program was suspended because of time constraints during this fieldwork. This work will be resumed during a second visit to the area.

Sediment was initially processed using two methods:

- Sediment was washed through a 63μm sieve. Material retained in the 63μm sieve was dried in a drying cabinet at 105ºC overnight and separated into three size fractions: >250μm, 250-160μm, and 160-63μm.
- Open WhirlPac bags were placed in a freeze dryer for 48 hours. When dry, the sediment was separated into four size fractions: >250μm, 250-125μm, 125-80μm, and <80μm.

Assessment of these two processing methods indicated that freeze drying yielded sediment that breaks down easily and is therefore easier to work with. The oven drying method yielded indurated blocks of sediment that are difficult to work with. For these reasons, all subsequent sediment processing was done using the freeze drying method. Prior to analysis, all residue fractions were stored in sterilin tubes following drying and sieving.

Ostracods

To extract ostracod valves, the dry residue was spread on a picking tray and inspected under a low power binocular microscope. Ostracod shells from the >160μm fractions were picked using a fine paintbrush and de-ionised water. These were stored on microfossil slides for cleaning and subsequent chemical and isotopic analysis.

Splitting the Cores

During the fieldwork, three long sediment cores, each approximately 8m in length, were recovered using a percussion corer from the anchored raft (Appendix I). The sediment recovered in the core tubes was grey, fine-grained, and uniform in structure. Several chironomid tubes were present at the core top, and molluscs (*Cerastoderma* sp.) were present in the upper 50cm. No obvious sedimentary structures were observed through the clear tube. The cores were kept in cold storage prior to splitting.

For splitting, the cores were transported to EAWAG, Kastanienbaum, Lucerne, Switzerland, by R.F. and K.K. in order to have the benefit of EAWAG's specialised equipment and staff expertise. Core splitting is a two-stage process. First the core was clamped into a jig and two blades positioned at opposite sides of the core are drawn along the plastic tube. Once the tubing has been cut, the sediment is divided by means of two thin, wet copper plates that are pushed across the diameter of the tube and then separated to leave the core in two halves. The copper plates are then removed to reveal the sediment in cross-section.

Initial Results

Core Lithology

Subsequent splitting of the cores did reveal some sedimentary structure (Figures 6 & 7). Much of the sediment was found to be grey, fine grained and either homogenous or with faint lighter and darker grey laminae. However, at some levels (most notably between 5.8 and 6.7m depth), distinct laminations were present. Some of these laminae are white or light brown, whereas others are black. The upper termination of this section of laminated sediment is marked by a single, brown, 2mm wide lamina, directly above which the sediment is mainly homogenous. Material from these laminae was examined under light and electron microscopes (Figure 8). The following observations were made:

1. Sample 2/4A - 42 cm (648cm below the sediment-water interface): black lamination. The fresh smear contained *Aulacoseira* and *Stephanodiscus*, which were common, with a few large desmids. Also present were 5-15µm grains that appeared to be quartz. Additionally, a considerable amount of background flocculate material with small particles was observed. When investigated using SEM and EDAX, common elements in the background material were Si, Al, O, and Fe. This suggests that the material comprises alumino-silicates, which are likely to be clay particles and clay aggregates. Also present were many small euhedral crystals, 2-3µm in size (Figure 8). The relative concentrations of the elements in these crystals were Ca 1.2, Al 0.37, 0.18, Mg and Na not significant, no S detected. This suggests that the crystals are carbonate, probably low Mg calcium carbonate ($Ca[Mg]CO_3$).
2. Sample 2/3E 43 cm (583cm below the sediment water interface): white lamina. The fresh smear contained no siliceous microfossils (although a few organic remains of planktonic algae were observed). Many very fine particles (< 5µm in size) were present. When investigated using SEM and EDAX, these particles where found to have high Ca concentration. Background material was probably alumino-silicates.
3. Sample 2/3E 42 cm (582cm below the sediment water interface): brown lamina. The fresh smear contained very few diatoms and no other microfossils were apparent. Many very fine particles 3-5µm were visible. When investigated using SEM and EDAX, these particles were found to consist of Ca (3.6), Al (0.2), and Si (0.16). No Mg, Na, or S was detected in these fine particles. A few amorphous larger (12-16µm) particles were present (Figure 8). Some of these had high silicon (quartz) content, whereas others were found to have a high Ca content. These particles are possibly detrital carbonate. The background material was found to consist of alumino-silicates.
4. Sample 2/3E 48 cm (588cm below the sediment water interface): white lamina. The fresh smear contained mainly very fine particles with no microfossils apparent. Investigation using SEM and EDAX found that the sample comprised amorphous background material with many small (2-3µm) euhedral crystals (Figure 8). The small euhedral crystals were found to have a high Ca content.

For samples 2, 3, and 4, when HCl was added to fresh smears, approximately 70% of the small particulate material dissolved over several seconds. However, in sample 2/4A-42cm, a considerable amount of amorphous material remained after acidification. From these preliminary investigations, it appears that there is a considerable amount of endogenic carbonate present in these samples.

Suite of Analyses to be Performed on the Cores

1. Magnetic analysis (I.F., R.F., & K.K. at Coventry University)
2. LOI measurements (K.K. at UCL)
3. Radiometric dating (Poznan Radiocarbon Laboratory, Poland)
4. Pollen analysis (S.P. at UCL)
5. Particle size analysis (M.S. & A.Z. in Zurich)
6. Trace metal analysis (J. Boyle in Liverpool)
7. Diatom analysis (R.F. at UCL. A.A.Z. at Tanta University, Egypt)
8. Microfossil analyses (R.A. at Mansoura University, Egypt. K.K. at UCL, Royal Holloway, and NIGL)
9. Stable isotope analyses (M.L. and K.K. at NERC Isotope Geochemistry Laboratories (NIGL))
10. Macrofossil analysis (H.B. in Bergen)
11. Carbonate mineralogy (W. Last, University of Manitoba, Canada)

Magnetic Susceptibility Analysis

Split cores were transported to the University of Coventry, Coventry, UK, for volume magnetic susceptibility (κ) measurements. Measurements were made using a Bartington MS2E high-resolution sensor. This instrument was used to take magnetic susceptibility measurements of the sediment at 0.5cm resolution. Magnetic susceptibility along the core varied from –2 to 75 (Figures 8 & 10, Appendix IV). Some initial observations:

- The base of the 8.3m core displays relatively high κ values (20 to 40). These values are coincident with sediment that is dryer than the rest of the core, and these high κ values may therefore be due to a concentration effect.
- From the high values at the base of the core, κ falls gradually to between -2 and 8, and remains at this level for c. 3.5m.
- From c. 3.9m depth in the core, there is a step-wise rise in volume magnetic susceptibility, culminating in the highest values in the core, which are coincident with two massive sedimentary units (Figure 6B). These massive units (and the magnetic susceptibility pulses) possibly represent periods of high detrital mineral influx into the lake.
- Above this level, values of κ remain relatively high (10 to 40) up to 1m depth. At this point the level falls to below 10, and remains low for the rest of the section.

Mass specific magnetic susceptibility analyses throughout the core are planned. Unexpectedly, there are no rhythmical changes in the cores that might be expected for continuous and regular Nile flood cycles. The two massive units (Figure 6B) probably result from major erosional episodes that might be expected from a major release of water into the depression.

Magnetic susceptibility results were used to cross-correlate cores QARU 2 and 3 (Figure 10). It was found that there was a good agreement between the κ values obtained from both cores, allowing a high degree of confidence when correlating between cores.

Loss on Ignition

Loss on ignition analyses were performed as a measure of the abundance of three sedimentary constituents, water content, organic content, and carbonate content. The results from these analyses are shown in Figure 9 (Appendix IV). The main features of these plots are:

- An increase in water content from the base of the core to 725cm, accompanied by a decrease in carbonate and a small increase in organic content;
- Relatively constant water content in the mid-sixties and then rises over 70% at a level where white laminations are present (between 610 and 580cm);
- An increase in carbonate content at the levels where white laminations are present;
- A decrease in water content coincident with increase in magnetic susceptibility and the massive sedimentary units (Figure 6B);
- Relatively constant organic content throughout the core with most values between 6% and 14%;
- For most of the core, carbonate content values varying between 4% and 15%; and
- An increase in variability from 37cm to the top of the core in water, organic, and carbonate contents.

Percent water content values were used in correlating between cores (Figure 11). The main features seen in both sets of data were highly comparable, allowing cross-correlations to be performed with a high degree of certainty.

Radiometric Dating

With an apparent lack of plant macrofossils for dating, it was decided to obtain ^{14}C AMS dates using bulk organic matter or endogenic carbonate. In order to compensate for problems due to the hard water and reservoir effects, a sample of known approximate age (1940) was analysed at the Poznan Radiocarbon Laboratory, Poland. The radiocarbon age for the endogenic fraction (<10μm) of this sample was found to be approximately 6,000yrBP. This sample is clearly affected to a great extent by either hard water or reservoir effects and possibly both. It is hoped that comparison with the organic fraction will enable a correction factor to be applied in order to obtain radiocarbon dates for this core.

In view of the unsatisfactory preliminary results from radiocarbon dating, Uranium Series Dating is being considered as an alternative. The suitability of this method will be evaluated and, if considered potentially useful, an application for dates will be submitted to the NERC facility at the Open University, Milton Keynes.

Pollen Analysis

Eight samples for pollen analysis have so far been taken and analysis is underway. Pollen appears to be sparse, but the remains of the green algae *Pediastrum* and *Botryococcus* were found, particularly in the sample from QARU 2/3B (Figure 4) (approximately 4m depth). These algae are associated with freshwater, indicating that the sediments at this depth were deposited in a freshwater lake.

Particle Size and Trace Metal Analyses

Samples for these analyses were taken from all parts of the core in order to obtain an overall picture. Additionally, some sections of the core were selected for a more detailed investigation. These sections include the dryer section at the base of the core; the laminated sections; and sections with high magnetic susceptibility values.

Diatom Analysis

Initial observations indicate that the occurrence of diatoms though the core is patchy. Diatoms present represent a variety of depositional environments. The assemblages from the upper part of the core indicate a saline environment, whereas those from c. 4m are indicative of freshwater.

Ostracod Analysis

Ostracods have been picked from surface sediments. The modern assemblage appears to be mono-specific (*Cyprideis torosa*). Representative ostracod valves have been cleaned and prepared for isotopic analysis at the NERC Isotope Geosciences Laboratory (NIGL), Keyworth, UK. Additionally, *C. torosa* valves from Core QARU 1 (Hawkes, 1999) have been selected for analysis. These ostracods will form a pilot study on the core, to determine the potential value of performing isotopic analysis on ostracods from the rest of the cores. Ostracods from ten levels were analysed. Initial results from these analyses are shown in Appendix V. The ostracods from core QARU 1 show an decrease in $\delta^{13}C$ from the base to the top of the core. This decrease may be due to variations in organic productivity, decreasing during deposition of the core, or may have been due to an increase in organic input to the lake over this time. The $\delta^{13}C$ value towards the top of QARU 1 (9-10cm) is similar to the $\delta^{13}C$ values for ostracods in the modern surface sediment samples. The $\delta^{18}O$ values have remained relatively constant during the period of deposition of this sediment.

Stable Isotope Analysis

Isotopic analysis of water samples, along with stable isotope analysis of the authigenic carbonate and bulk organic components of the sediment will be undertaken at NIGL. Initial results from analyses of water and surface sediment samples are shown in Appendix VI. Analysis of the bulk organic and authigenic carbonate components of the core sediment is currently underway.

Initial results from water analysis show that the $\delta^{13}C$ values of the drain water (Sites 17 and 18) are lower than the water sample from the Bahr Yusef (Site 19). This decrease in $\delta^{13}C$ values is probably due to an input of fresh organic material into the drains. Most of the $\delta^{13}C$ values of the lake water are enriched in relation to those of the drain water, the lowest values (Sites 15 and 16) were for water taken from a point close to where drain water enters the lake. This enrichment in lake water $\delta^{13}C$ values will be primarily due exchange with atmospheric CO_2. The $\delta^{18}O$ and δD values for water taken from the drains and the Bahr Yusef (Sites 17, 18, and 19) are all much lower than those values for lake water. This increase of $\delta^{18}O$ and δD values for lake water is probably due to evaporative concentration of the heavier isotopes in the lake. The relationship between $\delta^{18}O$ and δD can be represented by the equation $\delta D = 5.11.\delta^{18}O + 8.88$ with an R^2 value of 0.98. These water samples do not sit on the Global Meteoric Water Line that is represented by the equation $\delta D = 8.\delta^{18}O + 10$. The gradient for the Faiyum water samples is less than eight, indicating that the Faiyum water samples have undergone evaporation, as is normal in arid regions. Therefore, any variations in oxygen isotope composition that are present through the core mainly should reflect changes within the lake.

Elemental and isotopic analyses of the bulk organic material indicate that the greatest contribution was from aquatic algae. The $\delta^{13}C$ values are between 20‰ and 26‰, this is within the range for organic material derived from C_3 plants. The C/N ratios at the open water sites are between 7 and 10, which is typical of simple aquatic plants. At Site 16, the $\delta^{13}C$ value is lower than most other sites (21.7‰) and the C/N ration is higher than other sites (11.6), which could be due to an increase in the proportion of organic matter input from vascular plants.

Macrofossil Analysis

The incidence of plant macrofossils in the core appears to be very low. However, following drying, the >125μm size fraction of selected samples will be analysed for plant macrofossils, leave fragments, and oospores.

Discussion

When considering the data collected so far from this core, it is apparent that at some levels there are concurrent variations between the magnetic susceptibility measurements and the values obtained by loss on ignition analyses. Some of these variations are associated with distinct changes in the sediment core lithology. For example, the massive sedimentary units that lie around 3m depth in the core are clearly associated with fluctuations in magnetic susceptibility and water content (Figure 9). At other places, changes in measured values are accompanied by a lack of obvious change in lithology. An example of this can be seen from the base of the core to 725cm depth, where a substantial change in magnetic susceptibility measurements is accompanied by a significant change in the water content and carbonate content values (Figure 9) with no corresponding change in core lithology (Figure 6E).

Data collection is underway, and there is clearly a great deal more data that will be gathered from this core. Obtaining absolute dates will be essential in the development of an accurate, integrated palaeoenvironmental interpretation that takes into account both climatic variations and human activities. Initial results indicate that major environmental changes have occurred during deposition of the sediment core. An extremely variable depositional environment has driven major sedimentary changes. Sediment facies range from well-laminated to massive and homogenous deposits. Some of the sediments appear to have been laid down during very rapid catastrophic events (massive units, Figure 6B), whereas sediment facies from other levels in the core record periods of relatively quite conditions and cyclicity (Figures 6C & 6D). Prospects for using palaeolimnology to elucidate environmental changes in the Faiyum and the Nile catchment are promising.

One unusual and interesting aspect of the fieldwork observation was the presence of both saline and freshwater taxa in the lake. Recovery of gravity cores QARU 7 and 8, revealed serpulid worm tubes encrusting the sediment surface (Figure 5). These worm tubes, which are normally associated with marine conditions, were also seen in some of the eastern lake basin surface sediment samples where water depth was between 2.5m and 8m. However, the surface sediment of cores from other parts of the lake contained chironomid larvae tubes, which are usually associated with freshwater environments (although some species live in salt-water lagoons). The lake contains numerous species of marine fish that have been recently introduced since lake water salinity increased and the resident freshwater fish were unable to adapt to changes in lake water chemistry. However, we saw one species of 'freshwater' fish (*Tilapia*) being caught by fishermen, which seems to be tolerating the high salinity conditions in the lake.

Initial Conclusions

So far, data collected from these cores is proving to be interesting, and all indications are that the work currently underway on Lake Qarun will prove to be extremely valuable. It appears likely that this site will provide a significant contribution to our further understanding of environmental change within the Faiyum and its relationship to the palaeolimnology of Lake Qarun. This information will be extremely important in the study of the many lakes with long sediment records situated in populated areas. Successful study of these lakes depends on our ability to unravel and attribute the effects of human activity and climate.

The concurrent and on-going re-survey of the archaeological sites in the Faiyum will provide a unique insight into the ways in which environmental change has affected the people of the Faiyum and the resulting impact on the lake.

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Appendix I

Sediment Cores extracted between 13 and 15 April 2003.

First Coring Position

Core	Northing	Easting	Depth (m)	Sub-sample size (cm)	Sections		Total	Comments
Qaru 2/1	29.4805	30.59722	0.16 - 1.46	2				Gravity Core. Started 20cm
Qaru 2/2	29.4805	30.59722	0.42 - 2.99	1	A	62.0cm		Top overlapped by Qaru 2/1
				1	B	65.5cm		Top 20cm disturbed and discarded
				1	C	64.6cm		
				1	D	64.9cm	257cm	
Qaru 2/3	29.4805	30.59722	3.17 - 6.00	1	A	49.0cm		
				1	B	60.8cm		
				1	C	58.9cm		
				1	D	60.0cm		
				1	E	58.6cm	287.3cm	
Qaru 2/4	29.4805	30.59722	6.06 - 8.26	1	A	75.2cm		
				1	B	72.6cm		
				1	C	71.3cm	219.1cm	
Qaru 3/1	29.4805	30.59722	1.0 - 4.0	1	A	70.0cm		
				1	B	81.6cm		
				1	C	73.2cm		Overlaps gap in Core 2 at 3m depth
				1	D	65.9cm	290.7	
Qaru 3/2	29.4805	30.59722	4.0 - 7.0	1	A	80.0cm		
				1	B	82.6cm		
				1	C	71.0cm		Overlaps gap in Core 2 at 6m depth
				1	D	66.4cm	300.0	
Qaru 3/3	29.4805	30.59722	6.38 - 8.22	2			182.0	6.38 - 6.42cm, probably infill sediment.

Second coring position

Core	Northing	Easting	Depth (m)	Sub-sample size (cm)	Comments
Qaru 4/1	29.49668	30.61589	0 - 1.26		Qaru 4/1, 4/2, 4/3, and 4/4 were transported whole to Tanta University for diatom analysis.
Qaru 4/2			0.30 - 3.10		
Qaru 4/3			2.80 - 5.70		
Qaru 4/4			5.30 - 8.20		
Qaru 4/5			8.00 - 9.02	2	Base of Core 4. Recovered after piston cable broke. Alternate sections brought to UK, remaining samples transported to Tanta university.

Cores QARU 2/2, 2/3, 2/4, 3/1, and 3/2 were split into sections in order to aid transportation.

Approximately 8cm of sediment is lost during each core drive due to the core catcher assembly, hence the need for an overlapping series of cores.

Appendix II

Gravity Cores taken from Lake Qarun, 15 April 2003.

Core	Northing	Easting	Water Depth (m)	Sediment	Comments
Discarded	29.4913	30.66232	4.1	30cm	Hard grey sand
Qaru 6	29.48915	30.66228	5.9	58cm	
Qaru 7	29.48446	30.67491	5.7	74cm	8cm carbonate encrustation of worm tubes 14cm of black, flocculant sediment at the top of the core directly beneath the worm tubes.
Qaru 8	29.48005	30.69316	4.4	66cm	5cm carbonate encrustation of worm tubes 5cm of light and dark brown, flocculant sediment at the top of the core, directly beneath the worm tubes.

Appendix III

Surface sediment samples and water samples collected 13 April 2003.

	Northing	Easting	Water depth (m)	Sample numbers Sediment	Water	Macrophyte	Comments
Lake Qarun sites:							
Site 1	29.47653	30.74100	2.55	2	3		
Site 2	29.48508	30.74287	5.00	2			
Site 3	29.49677	30.74406	3.50	1	3		
Site 4	29.50775	30.73911	2.50	1			
Site 5	29.51083	30.73098	5.00	1	3		
Site 6	29.48412	30.58991	8.00	1	3		
Site 7	29.47472	30.58609	10.00	1			
Site 8	29.46650	30.58447	8.00	1	3		
Site 9	29.45481	30.58137	5.00	1			
Site 10	29.44439	30.58014	8.50	1	3		
Site 11	29.48860	30.64656	8.00	2	3		
Site 12	29.47882	30.64865	8.00	0			Surface too hard to recover sediment sample
Site 13	29.46822	30.64910	5.00	1	3		
Site 14	29.45450	30.64930	2.50	0			Surface too hard to recover sediment sample
Site 15	29.44658	30.64849	2.50	1	3		
Site 16	29.44471	30.65442	0.50	1	3		Drain inflow
El Bats Drain							
Site 17	29.49872	30.86136		1	3		c. 2km from Lake Qarun
Site 18	29.47455	30.96728		1	3	2	Tamya City
Bahr Yusef							
Site 19	29. 25019	30.91045		1	3	3	Close to Lahun. Sample taken at floating barrier. Silty water flowing from the river Nile.

Appendix IV

Initial results for QARU 1, 2, and 3.

QARU 1

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
0.5		85.80	24.22	13.25	36.0					71.5				
1.0					36.5		67.77	10.39	7.73	72.0				
1.5		87.04	23.53	17.55	37.0					72.5		65.96	10.92	11.09
2.0					37.5					73.0				
2.5		81.65	24.96	11.84	38.0					73.5				
3.0					38.5					74.0				
3.5		78.94	23.97	9.08	39.0					74.5		65.89	11.74	8.52
4.0					39.5		68.57	10.61	6.07	75.0				
4.5		79.85	22.30	9.69	40.0					75.5				
5.0					40.5					76.0				
5.5		77.36	16.20	9.88	41.0					76.5		66.56	10.68	9.19
6.0					41.5		67.74	9.51	13.39	77.0				
6.5		78.00	22.04	8.61	42.0					77.5				
7.0					42.5		66.38	8.98	11.58	78.0				
7.5		76.41	21.93	9.29	43.0					78.5		65.53	11.40	9.72
8.0					43.5					79.0				
8.5		78.33	21.53	10.37	44.0					79.5				
9.0					44.5		67.72	11.02	5.69	80.0				
9.5		72.58	19.27	8.29	45.0					80.5		68.07	11.12	9.02
10.0					45.5		60.04	8.36		81.0				
10.5		73.86	18.36	11.06	46.0					81.5				
11.0					46.5					82.0				
11.5		73.38	16.95	8.03	47.0					82.5		71.52	10.49	8.66
12.0					47.5					83.0				
12.5		72.27	18.03	8.68	48.0					83.5				
13.0					48.5		68.20	10.13	4.65	84.0				
13.5		72.35	21.43	7.72	49.0					84.5		71.79	10.33	8.09
14.0					49.5					85.0				
14.5		74.92	21.33	7.28	50.0					85.5				
15.0					50.5		67.67	10.42	5.48	86.0				
15.5		72.81	21.28	8.10	51.0					86.5		68.94	10.23	9.80
16.0					51.5					87.0				
16.5		73.13	15.63	10.80	52.0					87.5				
17.0					52.5		69.01	10.99	7.76	88.0				
17.5		69.81	14.44	10.36	53.0					88.5		68.69	11.69	8.23
18.0					53.5					89.0				
18.5					54.0					89.5				
19.0					54.5		69.56	9.89	7.32	90.0				
19.5		69.15	13.07	7.13	55.0					90.5		68.37	11.48	7.68
20.0					55.5					91.0				
20.5		66.08	11.28	16.57	56.0					91.5				
21.0					56.5		68.90	10.37	7.24	92.0				
21.5					57.0					92.5		71.56	10.36	9.12
22.0					57.5					93.0				
22.5		67.62	12.36	8.61	58.0					93.5				
23.0					58.5		69.47	10.06	8.06	94.0				
23.5					59.0					94.5		71.30	10.95	7.51
24.0					59.5					95.0				
24.5		69.70	11.67	8.07	60.0					95.5				
25.0					60.5		64.34	9.54	12.31	96.0				
25.5					61.0					96.5		70.32	10.30	8.22
26.0					61.5					97.0				
26.5		69.79	11.88	5.93	62.0					97.5				
27.0					62.5		67.08	9.65	5.38	98.0				
27.5					63.0					98.5		72.49	10.89	5.71
28.0					63.5					99.0				
28.5					64.0					99.5				
29.0					64.5		70.58	8.83	6.47	100.0				
29.5					65.0					100.5		74.42	10.56	7.24
30.0					65.5					101.0				
30.5		69.26	10.53	9.50	66.0					101.5				
31.0					66.5		70.08	9.82	6.68	102.0				
31.5					67.0					102.5		74.65	9.63	7.86
32.0					67.5					103.0				
32.5		68.32	11.68	6.28	68.0					103.5				
33.0					68.5		68.42	11.03	8.40	104.0				
33.5					69.0					104.5		74.35	9.67	7.38
34.0					69.5					105.0				

QARU 2/1

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
16.5	7.0	72.65	21.80	7.01	59.5					102.5	8.0	68.83	8.45	12.24
17.0					60.0					103.0				
17.5					60.5	11.0	63.90	8.62	13.24	103.5				
18.0					61.0					104.0				
18.5	1.0	70.81	18.74	7.53	61.5					104.5	8.9	69.16	10.10	10.01
19.0					62.0					105.0				
19.5					62.5	9.9	66.86	8.90	9.86	105.5				
20.0					63.0					106.0				
20.5	3.9	69.19	18.75	10.72	63.5					106.5	8.9	68.57	10.99	8.24
21.0					64.0					107.0				
21.5					64.5	9.9	67.58	9.06	10.51	107.5				
22.0					65.0					108.0				
22.5	7.9	66.37	13.40	15.83	65.5					108.5	9.8	68.53	11.61	6.91
23.0					66.0					109.0				
23.5					66.5	8.8	67.75	9.24	9.20	109.5				
24.0					67.0					110.0				
24.5	3.8	67.87	12.63	10.55	67.5					110.5	7.8	67.64	10.31	8.64
25.0					68.0					111.0				
25.5					68.5	6.8	68.87	9.83	8.61	111.5				
26.0					69.0					112.0				
26.5	5.8	70.69	11.82	8.74	69.5					112.5	9.8	69.25	10.13	10.36
27.0					70.0					113.0				
27.5					70.5	11.7	64.53	9.51	7.12	113.5				
28.0					71.0					114.0				
28.5	6.7	68.78	12.03	7.75	71.5					114.5	8.7	70.30	9.75	8.97
29.0					72.0					115.0				
29.5					72.5	9.7	66.74		5.29	115.5				
30.0					73.0					116.0				
30.5	10.7	69.44	12.22	9.22	73.5					116.5	9.7	69.22	9.42	10.06
31.0					74.0					117.0				
31.5					74.5	9.6	67.37	9.21	6.66	117.5				
32.0					75.0					118.0				
32.5	8.6	67.91	11.65	8.03	75.5					118.5	12.6	69.40	9.40	9.06
33.0					76.0					119.0				
33.5					76.5	10.6	69.57	10.51	8.27	119.5				
34.0					77.0					120.0				
34.5	7.6	68.35	10.90	8.79	77.5					120.5	12.6	67.48	9.71	11.73
35.0					78.0					121.0				
35.5					78.5	9.5	64.90	10.53	12.19	121.5				
36.0					79.0					122.0				
36.5	11.5	68.04	11.52	7.84	79.5					122.5	24.5	69.19	9.23	8.97
37.0					80.0					123.0				
37.5					80.5	9.5	64.66	10.87	10.94	123.5				
38.0					81.0					124.0				
38.5	12.5	67.57			81.5					124.5	26.5	68.14	10.05	8.16
39.0					82.0					125.0				
39.5					82.5	9.5	63.38	10.54	10.76	125.5				
40.0					83.0					126.0				
40.5	14.4	67.19	10.43	8.60	83.5					126.5	27.4	69.65	9.86	9.71
41.0					84.0					127.0				
41.5					84.5	9.4	64.36	10.39	10.90	127.5				
42.0					85.0					128.0				
42.5	13.4	67.64	10.85	7.42	85.5					128.5	25.4	71.32	9.76	11.06
43.0					86.0					129.0				
43.5					86.5	10.4	66.53	9.83	11.66	129.5				
44.0					87.0					130.0				
44.5	13.3	66.98	11.08	5.75	87.5					130.5	25.3	70.63	10.25	10.35
45.0					88.0					131.0				
45.5					88.5	11.3	69.69	10.95	9.39	131.5				
46.0					89.0					132.0				
46.5	14.3	67.16	10.67	7.46	89.5					132.5	31.3	71.03	10.11	10.08
47.0					90.0					133.0				
47.5					90.5	9.3	67.70	10.55	10.23	133.5				
48.0					91.0					134.0				
48.5	15.3	65.27	10.10	6.87	91.5					134.5	29.2	69.10	10.15	8.91
49.0					92.0					135.0				
49.5					92.5	9.2	67.72	9.75	10.33	135.5				
50.0					93.0					136.0				

QARU 2/2

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
41.5	3.0			
42.0	7.0	63.93	14.36	12.55
42.5	7.1			
43.0	6.1			
43.5	6.1			
44.0	9.2	62.13	8.41	18.53
44.5	10.2			
45.0	10.2			
45.5	9.3			
46.0	8.3	66.69	9.17	9.70
46.5	8.3			
47.0	7.4			
47.5	7.4			
48.0	7.4	67.83	9.00	8.16
48.5	7.5			
49.0	6.5			
49.5	4.5			
50.0	5.6	67.87	8.92	9.48
50.5	10.6			
51.0	12.6			
51.5	12.7			
52.0	12.7	66.49	8.65	9.15
52.5	12.7			
53.0	12.7			
53.5	12.8			
54.0	12.8	65.65	10.48	6.35
54.5	11.8			
55.0	8.9			
55.5	9.9			
56.0	10.9	68.43	10.09	6.26
56.5	12.0			
57.0	12.0			
57.5	11.0			
58.0	9.1	66.22	10.18	6.44
58.5	8.1			
59.0	8.1			
59.5	8.2			
60.0	7.2	68.00	10.17	6.80
60.5	6.2			
61.0	6.3			
61.5	5.3			
62.0	4.3	65.77	10.75	7.26
62.5	5.4			
63.0	7.4			
63.5	6.4			
64.0	6.5	66.20	10.32	5.98
64.5	6.5			
65.0	6.5			
65.5	6.6			
66.0	7.6	65.91	10.45	5.96
66.5	7.6			
67.0	7.7			
67.5	5.7			
68.0	5.7	67.02	9.72	5.67
68.5	5.8			
69.0	6.8			
69.5	7.8			
70.0	6.9	67.02	9.93	5.59
70.5	5.9			
71.0	5.9			
71.5	5.0			
72.0	4.0	65.56	10.22	5.28
72.5	4.0			
73.0	4.0			
73.5	5.1			
74.0	5.1	66.73	10.17	6.78
74.5	6.1			
75.0	6.2			

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
102.0	4.9	67.76	10.88	7.32
102.5	5.9			
103.0	6.0			
103.5	5.0			
104.0		72.57	9.35	8.08
104.5				
105.0	3.0			
105.5	4.0			
106.0	5.0	68.73	8.84	9.13
106.5	5.0			
107.0	4.9			
107.5	6.9			
108.0	6.9	69.05	9.34	9.96
108.5	6.9			
109.0	6.9			
109.5	4.9			
110.0	4.8	69.23	9.64	8.92
110.5	4.8			
111.0	4.8			
111.5	5.8			
112.0	4.8	68.54	9.20	10.11
112.5	4.8			
113.0	4.7			
113.5	4.7			
114.0	4.7	70.99	9.22	8.77
114.5	4.7			
115.0	4.7			
115.5	4.7			
116.0	4.6	67.57	9.07	9.52
116.5	4.6			
117.0	6.6			
117.5	7.6			
118.0	7.6	69.75	9.21	10.20
118.5	8.6			
119.0	9.5			
119.5	10.5			
120.0	12.5	68.08	8.66	9.76
120.5	11.5			
121.0	13.5			
121.5	18.5			
122.0	20.4	69.92		
122.5	20.4			
123.0	18.4			
123.5	20.4			
124.0	24.4	71.77	9.42	9.27
124.5	17.4			
125.0	13.3			
125.5	11.3			
126.0	11.3	71.31	9.04	9.05
126.5	14.3			
127.0	23.3			
127.5	25.3			
128.0	25.3	71.04	8.96	9.64
128.5	26.2			
129.0	26.2			
129.5	26.2			
130.0	28.2	68.43	9.13	8.96
130.5	25.2			
131.0	27.2			
131.5	30.1			
132.0	29.1	68.01	8.48	10.42
132.5	27.1			
133.0	32.1			
133.5	31.1			
134.0	31.1	67.81	9.03	9.55
134.5	32.0			
135.0	31.0			
135.5	33.0			

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
162.5	32.1			
163.0	32.1			
163.5	33.1			
164.0	31.1	68.06	7.68	10.83
164.5	30.1			
165.0	31.1			
165.5	30.0			
166.0	32.0	69.18	7.96	10.96
166.5	31.0			
167.0	22.0			
167.5				
168.0		70.42	8.26	10.54
168.5				
169.0		71.20	10.05	9.04
169.5				
170.0	33.0			
170.5	31.0			
171.0	30.9	69.29	11.20	8.50
171.5	33.9			
172.0	37.8			
172.5	38.8			
173.0	33.7	69.99		
173.5	36.7			
174.0	37.6			
174.5	36.6			
175.0	36.5	68.90	11.37	8.30
175.5	33.5			
176.0	34.4			
176.5	35.4			
177.0	35.3	69.61	8.43	11.00
177.5	36.3			
178.0	35.2			
178.5	33.2			
179.0	28.1	70.69	8.52	9.32
179.5	29.1			
180.0	29.0			
180.5	28.0			
181.0	27.9	70.66	10.42	9.05
181.5	27.9			
182.0	27.8			
182.5	27.8			
183.0	28.7	69.80	10.82	8.64
183.5	27.7			
184.0	26.6			
184.5	29.6			
185.0	28.5	70.73	9.85	7.56
185.5	28.5			
186.0	27.5			
186.5	26.4			
187.0	26.4	71.85	8.77	10.43
187.5	25.3			
188.0	26.3			
188.5	25.2			
189.0	26.2	71.50		
189.5	26.1			
190.0	30.1			
190.5	30.0			
191.0	29.0	70.88	9.53	9.84
191.5	27.9			
192.0	27.9			
192.5	28.8			
193.0	28.8	71.11	8.29	10.14
193.5	29.7			
194.0	30.7			
194.5	32.6			
195.0	32.6	71.49	11.96	8.84
195.5	32.5			
196.0	35.5			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
223.0	16.9	66.21	9.38	9.23	298.0					273.0	21.6			
223.5	18.9				298.5		68.12	8.60	8.64	273.5	20.6			
224.0	26.8				248.5	13.2	70.46	8.78	6.56	274.0	20.6			
224.5	35.8				249.0	13.1				274.5		69.15		
225.0	35.7	68.52	8.31	8.46	249.5	13.1				275.0	22.5			
225.5	34.7				250.0	13.1				275.5	22.5			
226.0	24.6				250.5	13.1	70.34	9.31	6.65	276.0	21.5			
226.5	16.6				251.0	13.0				276.5	21.4	68.73	8.93	7.66
227.0	15.5	66.31	10.47	7.40	251.5	14.0				277.0	21.4			
227.5	15.5				252.0	14.0				277.5	22.4			
228.0	14.4				252.5	12.9	70.52	8.61	7.10	278.0	22.4			
228.5	14.4				253.0	12.9				278.5	22.3	71.26	10.50	5.69
229.0	12.3	66.59	10.29	7.64	253.5	12.9				279.0	22.3			
229.5	13.3				254.0	12.8				279.5	21.3			
230.0	21.2				254.5	12.8	70.41			280.0	22.2			
230.5	27.2				255.0	12.8				280.5	22.2	68.79	10.33	6.73
231.0	28.1	71.03	10.20	7.73	255.5	12.7		7.05	7.72	281.0	23.2			
231.5	27.1				256.0	13.7				281.5	22.1			
232.0	25.0				256.5	13.7	69.88			282.0	23.1			
232.5	22.0				257.0	13.6				282.5	23.1	66.69	10.55	7.03
233.0		70.09	10.13	7.61	257.5	13.6		7.82	7.07	283.0	24.0			
233.5					258.0	13.6				283.5	24.0			
234.0					258.5	13.6	69.57	7.38	7.44	284.0	24.0			
234.5		66.26	8.97		259.0	12.5				284.5	23.9	71.02	10.36	5.61
235.0					259.5	14.5				285.0	23.9			
235.5	17.0				260.0	13.5				285.5	24.9			
236.0	21.0				260.5	13.4	69.55			286.0	26.9			
236.5	19.9	71.84			261.0	13.4				286.5	28.8	67.03	10.86	6.62
237.0	19.9				261.5	14.4				287.0	28.8			
237.5	20.9				262.0	14.3				287.5	30.8			
238.0	21.8				262.5	14.3	69.13	8.86	8.68	288.0	29.7			
238.5	22.8	73.99	9.80	6.52	263.0	14.3				288.5	27.7	69.85	9.34	7.02
239.0	20.8				263.5	14.2				289.0	24.7			
239.5	19.7				264.0	16.2				289.5	24.6			
240.0	17.7				264.5	17.2	69.44	8.47	8.58	290.0	24.6			
240.5	15.7	69.56	8.62	6.66	265.0	18.1				290.5	24.6	69.52	8.33	9.38
241.0	16.7				265.5	19.1				291.0	23.5			
241.5	16.6				266.0	21.1				291.5	20.5			
242.0	16.6				266.5	20.0	69.71	7.76	7.93	292.0	17.5			
242.5	15.6	70.31	8.05	7.55	267.0	18.0				292.5	19.4	67.03	8.18	8.36
243.0	13.5				267.5	18.0		8.00	6.30	293.0	20.4			
243.5	13.5				268.0	17.0				293.5	22.4			
244.0	12.5				268.5	14.9	73.32	10.61	5.26	294.0	23.3			
244.5	12.4	71.39			269.0	15.9				294.5	24.3	66.11		
245.0	12.4				269.5	13.9		8.48	7.31	295.0	27.3			
245.5	12.4				270.0	15.8				295.5	28.3			
246.0	11.3				270.5	18.8	69.41	8.49	7.38	296.0	35.2			
246.5	11.3	70.63			271.0	24.8				296.5	46.2	66.92	9.20	8.97
247.0	11.3				271.5	27.7				297.0	57.2			
247.5	11.2				272.0	25.7				297.5				
248.0	13.2				272.5	25.7	68.77	8.36	8.81					

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
317.0	60.5	57.92	9.75	6.80	380.0	7.1				443.0	2.7	73.95	7.50	11.53
317.5	60.4				380.5	10.1				443.5	2.7			
318.0	61.4	59.14	7.83	9.05	381.0	11.0				444.0	3.7	74.09	6.86	10.15
318.5	61.3				381.5	13.0	70.7971845	8.74439462	11.8161435	444.5	3.8			
319.0	69.2	57.14			382.0	14.0				445.0	3.8	72.51	6.74	9.70
319.5	67.2				382.5	15.0				445.5	2.8			
320.0	35.1	72.50	9.32	7.76	383.0	15.9				446.0	2.8	73.36	7.18	9.52
320.5	28.1				383.5	17.9	71.3755413	7.78097983	11.9538905	446.5	2.8			
321.0	22.0	73.69	9.57	6.18	384.0	15.9				447.0	2.8	76.18	6.73	11.18
321.5	21.9				384.5	12.9				447.5	1.9			
322.0	20.9	75.30	8.96	6.84	385.0	13.8				448.0	2.9	76.69	7.58	9.49
322.5	25.8				385.5	12.8	71.1265647	7.12909441	11.5298651	448.5	2.9			
323.0	26.7	70.38	9.45	7.23	386.0	11.8				449.0	2.9	75.34	8.36	10.12
323.5	26.7				386.5	11.8				449.5	1.9			
324.0	30.6	68.56	9.95	6.76	387.0	10.7				450.0	2.9	74.77	8.36	9.22
324.5	35.5				387.5	9.7	75.4464286	7.27272727	11.3038961	450.5	2.0			
325.0	25.5	66.55	7.59	9.70	388.0	9.7				451.0	3.0	76.74	9.03	8.57
325.5	21.4				388.5	9.7				451.5	2.0			
326.0	20.4	70.69	8.90	9.85	389.0	9.6				452.0	3.0	77.10		9.01
326.5	20.3				389.5	9.6	73.9441792	7.75193798	10.4467935	452.5	3.0			
327.0	19.2	68.78	8.83	7.46	390.0	9.6				453.0	2.1	77.46	8.67	8.45
327.5	21.2				390.5	9.6				453.5	3.1			
328.0	19.1	69.37	10.91	7.71	391.0	9.5				454.0	2.1	76.62	8.08	9.91
328.5	24.0				391.5	8.5	71.8020216	9.33250927	8.23733004	454.5	2.1			
329.0	27.0	66.93	7.91	9.62	392.0	8.5				455.0	3.1	76.55	7.90	9.23
329.5	19.9				392.5	8.5				455.5	3.1			
330.0	16.9	70.63	8.96	11.01	393.0	9.4				456.0	3.2	76.22	7.42	9.34
330.5	17.8				393.5	10.4	70.3928571	7.53920386	11.2376357	456.5	3.2			
331.0	16.7	70.53	8.76	9.52	394.0	11.4				457.0	2.2	75.85	7.44	9.29
331.5	16.7				394.5	11.4				457.5	3.2			
332.0	16.6	70.30	9.71	7.26	395.0	9.3				458.0	2.2	76.37	7.15	10.68
332.5	19.5				395.5	9.3	70.5139766	9.55657492	7.27828746	458.5	3.2			
333.0	15.5	72.07	10.22	6.40	396.0	8.3				459.0	3.3	77.25	7.70	10.20
333.5	14.4				396.5	8.3				459.5	2.3			
334.0	15.3	70.79	10.13	7.00	397.0	8.2				460.0	2.3	78.12	7.63	9.38
334.5	16.3				397.5	8.2	70.4246784	9.26099158	6.67913938	460.5	2.3			
335.0	22.2	71.33	9.34	7.45	398.0	8.2				461.0	3.3	77.68	8.43	8.75
335.5	14.2				398.5	9.2				461.5	2.3			
336.0	11.1	71.57	9.00	8.12	399.0	8.1				462.0	2.4	76.98	7.71	11.44
336.5	12.0				399.5	8.1	71.6292458	9.94318182	7.78246753	462.5	3.4			
337.0	12.0	71.29	9.41	6.88	400.0	8.1				463.0	2.4	77.02	8.98	10.24
337.5	12.9				400.5	9.1				463.5	3.4			
338.0	10.8	72.00	9.01	7.08	401.0	8.0				464.0	2.4	76.89	8.49	10.10
338.5	10.8				401.5	7.0	71.9663512	8.62715679	8.36609152	464.5	2.4			
339.0	14.7	72.24	10.08	7.59	402.0	7.0				465.0	2.5	77.17	8.26	10.79
339.5	11.7				402.5	7.0				465.5	1.5			
340.0	8.6	70.44	9.72	7.85	403.0	7.9				466.0	2.5	78.41	8.86	11.24
340.5	7.5				403.5	6.9	71.0781517	8.33333333	9.12031558	466.5	2.5			
341.0	8.5	71.21	9.88	8.04	404.0	5.9				467.0	2.5	77.62	8.33	10.20
341.5	9.4				404.5	5.9				467.5	2.6			
342.0	8.3	72.14	8.29	9.65	405.0	5.8				468.0	2.6	77.92	9.70	9.70
342.5	9.3				405.5	4.8	68.9131642	12.2692079	8.66706373	468.5	2.6			
343.0	9.2	72.80	9.99	6.36	406.0	5.8				469.0	2.6	75.29	9.86	12.32
343.5	8.1				406.5	6.8				469.5	2.6			
344.0	8.1	73.49	10.28	7.49	407.0	6.7				470.0	2.6	74.80		
344.5	7.0				407.5	6.7	68.8323286	8.02292264	8.67048711	470.5	2.7			
345.0	8.0	71.94	9.98	5.86	408.0	6.7				471.0	2.7	74.30	10.06	12.01
345.5	6.9				408.5	6.7				471.5	2.7			
346.0	7.8	72.85	10.41	6.71	409.0	6.6				472.0	2.7	75.42	9.63	10.78
346.5	8.8				409.5	7.6	68.2086614	7.87262273	8.96240602	472.5	2.7			
347.0	8.7	70.28	10.49	6.27	410.0	7.6				473.0	2.7	75.12	9.30	11.61
347.5	8.6				410.5	7.6				473.5	2.8			
348.0	8.6	73.98	10.86	6.21	411.0	6.5				474.0	2.8	74.80	10.71	9.23
348.5	9.5				411.5	6.5	72.6264135	8.88542479	8.16212003	474.5	3.8			
349.0	12.5	73.20	8.49	9.92	412.0	6.5				475.0	2.8	73.51	9.88	11.66
349.5	13.4				412.5	6.5				475.5	3.8			
350.0	12.3	67.92	10.82	7.54	413.0	5.4				476.0	3.8	72.98	10.69	10.05
350.5	12.3				413.5	7.4	71.1981071	8.96191187	6.70351008	476.5	2.9			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
506.0	-0.8	74.35	8.40	10.26	537.5	0.1				569.0	4.3	71.75	11.59	7.18
506.5	0.2				538.0	0.1	71.26	13.07	7.74	569.5	5.4			
507.0	0.2	75.78	8.09	9.33	538.5	-0.9				570.0	4.4	72.05	12.12	6.91
507.5	0.1				539.0	-0.9	71.38	11.61	8.68	570.5	4.5			
508.0	0.1	74.56	8.62	9.60	539.5	0.0				571.0	3.5	70.91	12.68	6.66
508.5	0.1				540.0	0.0	74.33	12.18	5.70	571.5	4.5			
509.0	0.1	75.00	8.46	9.30	540.5	-1.0				572.0	3.6	69.88	11.48	8.46
509.5	0.1				541.0	-1.0	73.71	12.85	5.90	572.5	4.6			
510.0	0.1	73.78	8.25	10.46	541.5					573.0	3.7	71.03	11.15	8.22
510.5	0.0				542.0		74.93	10.30	12.40	573.5	3.7			
511.0	0.0	75.05	8.22	10.30	542.5	1.0				574.0	3.8	74.05	10.57	7.13
511.5	-1.0				543.0	2.0	72.97	11.19	14.48	574.5	3.8			
512.0	-1.0	73.99	8.92	11.55	543.5	2.1				575.0	3.9	74.07	10.84	6.94
512.5	-2.0				544.0	2.1	74.15	10.12	11.67	575.5	3.9			
513.0	-2.0	74.65	8.90	10.10	544.5	2.2				576.0	2.9	73.53	10.39	6.96
513.5	-1.1				545.0	2.2	74.40	8.99	13.59	576.5	4.0			
514.0	-1.1	75.02	7.90	11.88	545.5	2.3				577.0	4.0	73.58	10.10	7.00
514.5	-1.1				546.0	2.3	74.73	10.70	13.01	577.5	4.1			
515.0	-1.1				546.5	3.4				578.0	4.1	72.73	8.70	9.14
515.5	-1.1				547.0	2.4	72.35	11.75	8.96	578.5	3.2			
516.0	-1.1	73.42	8.15	9.29	547.5	2.4				579.0	3.2	72.94	9.91	7.74
516.5	-0.2				548.0	3.5	73.48	12.70	9.34	579.5	3.2			
517.0	-0.2	72.75	9.43	9.51	548.5	3.5				580.0	3.3	72.08	9.44	8.69
517.5	-0.2				549.0	3.6	73.69	10.77	11.39	580.5	3.3			
518.0	-0.2	73.27	9.00	11.87	549.5	2.6				581.0	3.4	72.41	9.82	7.96
518.5	-2.2				550.0	2.7	74.97	8.99	12.90	581.5	3.4			
519.0	-2.2	74.08	9.00	10.82	550.5	2.7				582.0	4.5	73.18	9.74	8.09
519.5	-0.3				551.0	3.7	74.03	10.51	13.79	582.5	3.5			
520.0	-0.3	73.20	11.24	8.76	551.5	2.8				583.0	3.6	71.49	9.72	8.29
520.5	-0.3				552.0	2.8	74.67	8.73	13.16	583.5	3.6			
521.0	-0.3	73.70	9.87	7.94	552.5	3.9				584.0	3.6	72.11	8.84	7.64
521.5	-1.3				553.0	3.9	73.32	10.38	12.43	584.5	2.7			
522.0	-1.3	72.64			553.5	4.0				585.0	3.7	73.95	9.06	9.06
522.5	-1.4				554.0	4.0	73.35	11.28	7.96	585.5	3.8			
523.0	-1.4	72.42	9.81	8.06	554.5	5.1				586.0	3.8	72.98	8.01	8.08
523.5	-0.4				555.0	4.1	72.67	9.59	11.27	586.5	3.9			
524.0	-0.4	72.74	10.53	7.16	555.5	4.1				587.0	2.9	72.29	7.32	9.60
524.5	-0.4				556.0	4.2	73.47	10.43	12.05	587.5	2.9			
525.0	-0.4	72.59	9.76	9.56	556.5	3.2				588.0	3.0	72.41	7.53	9.36
525.5	-1.5				557.0	3.3	73.12	9.70	12.62	588.5	3.0			
526.0	-1.5	72.51	10.91	10.57	557.5	4.3				589.0	3.1	73.04	8.98	9.51
526.5	-0.5				558.0	3.4	73.37	8.99	11.81	589.5	2.1			
527.0	-0.5	68.80	12.12	13.26	558.5	3.4				590.0	3.2	71.82	7.70	8.47
527.5	-1.6				559.0	3.4	71.94	9.41	14.29	590.5	4.2			
528.0	-1.6	72.34	8.83	11.71	559.5	3.5				591.0	3.3	71.41	9.36	10.31
528.5	-1.6				560.0	3.5	74.53	11.88	9.69	591.5	4.3			
529.0	-1.6	72.68	9.20	11.38	560.5	3.6				592.0	4.3	73.03	6.58	11.97
529.5	-0.6				561.0	3.6	72.26	12.85	8.27	592.5	3.4			
530.0	-0.6	71.89	10.94	8.75	561.5	3.7				593.0	3.4	70.75	7.98	12.87
530.5	-1.7				562.0	3.7	73.54	13.08	7.90	593.5	3.5			
531.0	-1.7	72.79	11.37	8.64	562.5	3.8				594.0	4.5	72.36	7.92	12.23
531.5	-0.7				563.0	3.8	73.68	13.10	8.26	594.5	4.6			
532.0	-0.7	72.84	11.63	8.46	563.5	2.8				595.0	3.6	67.72	9.61	13.27
532.5	-0.7				564.0	3.9	74.22	13.30	7.79	595.5	4.6			
533.0	-0.7	73.36	11.73	8.73	564.5	3.9				596.0	4.7	70.29	7.82	12.76
533.5	-0.8				565.0	3.0	73.73	13.47	7.18	596.5	3.7			
534.0	-0.8	73.92	12.38	8.88	565.5	4.0				597.0	3.8	69.53	7.57	12.74
534.5	-0.8				566.0	4.1	73.63	11.99	7.57	597.5	4.8			
535.0	-0.8	73.68	9.36	11.49	566.5	5.1				598.0	4.9	69.75	8.41	11.75
535.5	0.2				567.0	4.1	73.11	11.98	7.18	598.5	5.9			
536.0	0.2	72.50	9.42	9.26	567.5	4.2				599.0	6.0	69.46	8.59	10.95
536.5	-0.9				568.0	4.2	71.84	11.35	7.20	599.5	6.0			
537.0	-0.9	73.15	11.00	8.95	568.5	4.3								

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
606.5	5.0	67.27	11.15	11.95	679.5	5.0	65.28	7.75	9.12	752.5	6.1	64.10	8.05	8.94
607.0	5.0				680.0	5.0				753.0	6.0			
607.5	5.0	66.53	9.95	11.77	680.5	5.0	64.97	7.68	9.54	753.5	6.0			
608.0	5.0				681.0	5.0				754.0	5.0			
608.5	5.0	65.81	9.97	11.93	681.5	4.0	64.45	7.64	11.66	754.5	5.0	64.84	7.83	9.87
609.0	5.0				682.0	4.0				755.0				
609.5	4.0	67.08	10.06	11.63	682.5		67.34	7.44	9.61	755.5		65.44	8.11	10.24
610.0	4.0				683.0	4.0				756.0	7.0			
610.5	5.0	67.40	10.15	12.26	683.5	4.0				756.5	6.9			
611.0	5.0				684.0	4.0				757.0	7.8			
611.5	4.0	66.86	9.45	10.73	684.5	4.0	66.43	7.95	7.64	757.5	7.8	67.53	8.54	10.44
612.0	4.0				685.0	3.9				758.0	6.7			
612.5	4.0	67.86	9.94	10.16	685.5	3.9				758.5	6.6			
613.0	4.0				686.0	3.9				759.0	6.5			
613.5	3.0	67.55	10.45	9.41	686.5	3.9	64.70	6.62	10.79	759.5	6.4	64.99	7.51	9.93
614.0	3.0				687.0	3.9				760.0	5.3			
614.5	5.0	67.73	9.61	8.47	687.5	3.9				760.5	5.3			
615.0	5.0				688.0	4.9				761.0	5.2			
615.5	4.0	68.05	8.79	7.89	688.5	4.9	66.07	7.13	5.49	761.5	5.1	63.68	7.73	9.76
616.0	4.0				689.0	4.8				762.0	5.0			
616.5	4.0	65.91	9.67	10.76	689.5	4.8				762.5	4.9			
617.0	4.0				690.0	4.8				763.0	6.9			
617.5	4.0	67.03	8.66	10.80	690.5	4.8	63.52	7.35	4.62	763.5	6.8	60.31	7.18	10.04
618.0	4.0				691.0	4.8				764.0	6.7			
618.5	4.0	66.55	8.88	8.83	691.5	4.8				764.5	6.6			
619.0	4.0				692.0	3.7				765.0	11.5			
619.5	6.0	65.86	9.33	7.34	692.5	3.7	65.76	7.41	8.47	765.5	11.4	49.82	5.92	13.00
620.0	6.0				693.0	4.7				766.0	12.4			
620.5	4.0	64.90	9.34	9.15	693.5	4.7				766.5	11.3			
621.0	4.0				694.0	3.7				767.0	12.2			
621.5	5.0	64.76	9.23	8.86	694.5	3.7	64.02	7.01	9.02	767.5	11.1	49.55	6.37	11.29
622.0	5.0				695.0	3.7				768.0	13.0			
622.5	4.0	66.41	8.62	10.08	695.5	3.7				768.5	12.9			
623.0	4.0				696.0	3.6				769.0	12.9			
623.5	4.0	66.04	8.78	11.03	696.5	3.6	65.30	8.08	7.47	769.5	13.8	47.13	6.42	11.37
624.0	4.0				697.0	3.6				770.0	13.7			
624.5	4.0	66.47	8.80	11.67	697.5	3.6				770.5	13.6			
625.0	4.0				698.0	3.6				771.0	14.5			
625.5	3.0	65.04	8.74	11.28	698.5	3.6	64.95	7.76	6.10	771.5	14.5	46.43	6.43	12.30
626.0	3.0				699.0	3.5				772.0	14.4			
626.5	4.0	66.08	9.12	11.68	699.5	3.5				772.5	15.3			
627.0	4.0				700.0	3.5				773.0	16.2			
627.5	5.0	64.85	9.08	8.90	700.5	3.5	68.24	8.05	7.27	773.5	16.1	42.49	6.33	12.56
628.0	5.0				701.0	2.5				774.0	15.0			
628.5	5.0	67.12	8.91	8.13	701.5	2.5				774.5	16.0			
629.0	5.0				702.0	2.5				775.0	14.9			
629.5	4.0	65.26	8.30	11.69	702.5	2.5	66.88	7.94	6.65	775.5	13.8	42.89	6.30	11.76
630.0	4.0				703.0	3.4				776.0	14.7			
630.5	4.0	67.75	8.90	9.05	703.5	3.4				776.5	14.6			
631.0	4.0				704.0	3.4				777.0	13.6			
631.5	4.0	66.66	8.56	11.06	704.5	3.4	66.81	7.72	8.13	777.5	13.5	42.34	6.44	12.52
632.0	4.0				705.0	3.4				778.0	13.4			
632.5	4.0	66.59	8.30	12.13	705.5	3.4				778.5	13.3			
633.0	4.0				706.0	3.4				779.0	13.2			
633.5	5.0	66.68	8.83	11.15	706.5	3.4	65.80	7.61	8.59	779.5	13.1	45.49	6.31	11.99
634.0	5.0				707.0	3.3				780.0	14.1			
634.5	4.0	67.74	9.08	10.14	707.5	3.3				780.5	14.0			
635.0	4.0				708.0	3.3				781.0	14.9			
635.5	4.0	64.68	9.33	8.53	708.5	3.3	66.19	6.52	8.62	781.5	14.8	45.25	6.55	12.14
636.0	4.0				709.0	3.3				782.0	14.7			
636.5	4.0	69.29	8.93	10.88	709.5	3.3				782.5	15.6			
637.0	4.0				710.0	4.2				783.0	14.6			
637.5	4.0	68.48	8.15	10.46	710.5	4.2	65.73	8.41	7.00	783.5	13.5	40.38	6.47	12.15
638.0	4.0				711.0	4.2				784.0	12.4			
638.5	4.0	68.16	9.92	9.18	711.5	4.2				784.5	17.3			
639.0	4.0				712.0	4.2				785.0	16.2			
639.5	4.0	69.04	8.74	10.28	712.5	4.2	66.85	8.02	8.22	785.5	17.2	43.03	6.42	12.35
640.0	4.0				713.0	4.2				786.0	18.1			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
136.0	34.0			
136.5	34.9			
137.0	37.9			
137.5	38.8			
138.0	37.8			
138.5	32.7			
139.0	33.7			
139.5	34.6			
140.0	34.5			
140.5	34.5			
141.0	33.4			
141.5	33.4			
142.0	34.3			
142.5	36.2			
143.0	36.2			
143.5	36.1			
144.0	36.1			
144.5	38.0			
145.0	37.0			
145.5	35.9			
146.0	35.8			
146.5	32.8			
147.0	33.7			
147.5	34.7			
148.0	33.6			
148.5	35.6			
149.0	34.5			
149.5	34.4			
150.0	34.4			
150.5	33.3			
151.0	34.3			
151.5	34.2			
152.0	34.1			
152.5	33.1			
153.0	32.0			
153.5	34.0			
154.0	34.9			
154.5	33.9			
155.0	34.8			
155.5	35.7			
156.0	35.7			
156.5	34.6			
157.0	38.6			
157.5	37.5			
158.0	35.4			
158.5	35.4			
159.0	37.3			
159.5	41.3			
160.0	37.2			
160.5	34.2			
161.0	31.1			
161.5	33.0			
162.0	37.0			
162.5	37.9			
163.0	39.9			
163.5	33.8			
164.0	35.8			
164.5	35.7			
165.0	35.6			
165.5	37.6			
166.0	34.5			
166.5	35.5			
167.0	37.4			
167.5	43.3			
168.0	46.3			
168.5	42.2			
169.0	44.2			
169.5	46.1			

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
206.0				
206.5	39.0			
207.0	49.0			
207.5	41.0			
208.0	38.0			
208.5	37.0			
209.0	32.0			
209.5	36.0			
210.0	40.9			
210.5	59.9			
211.0	45.9			
211.5	35.9			
212.0	29.9			
212.5	28.9			
213.0	29.9			
213.5	30.9			
214.0	31.9			
214.5	32.9			
215.0	30.9			
215.5	34.9			
216.0	39.9			
216.5	40.8			
217.0	29.8			
217.5	31.8			
218.0	34.8			
218.5	32.8			
219.0	32.8			
219.5	33.8			
220.0	32.8			
220.5	32.8			
221.0	32.8			
221.5	33.8			
222.0	31.8			
222.5	33.8			
223.0	34.7			
223.5	25.7			
224.0	21.7			
224.5	21.7			
225.0	20.7			
225.5	19.7			
226.0	19.7			
226.5	21.7			
227.0	22.7			
227.5	22.7			
228.0	21.7			
228.5	20.7			
229.0	26.7			
229.5	26.6			
230.0	20.6			
230.5	17.6			
231.0	15.6			
231.5	14.6			
232.0	14.6			
232.5	13.6			
233.0	13.6			
233.5	14.6			
234.0	12.6			
234.5	12.6			
235.0	12.6			
235.5	13.6			
236.0	11.5			
236.5	12.5			
237.0				
237.5	11.5			
238.0				
238.5	11.5			
239.0				
239.5	10.5			

Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
276.0	32.2			
276.5	30.2			
277.0	32.2			
277.5	31.1			
278.0	31.1			
278.5	27.1			
279.0	27.1			
279.5	28.1			
280.0	27.1			
280.5	27.1			
281.0	26.1			
281.5	26.1			
282.0	27.1			
282.5	27.1			
283.0	28.1			
283.5	27.1			
284.0	28.0			
284.5	29.0			
285.0	28.0			
285.5	25.0			
286.0	25.0			
286.5	24.0			
287.0	22.0			
287.5				
288.0				
288.5	21.0	69.56	7.83	8.37
289.0	25.0			
289.5	24.9			
290.0	24.9			
290.5	22.8	72.82	7.05	9.22
291.0	17.8			
291.5	16.7			
292.0	16.7			
292.5	18.6	70.02	7.07	8.62
293.0	20.6			
293.5	21.5			
294.0	21.5			
294.5	21.4	68.81	7.49	8.32
295.0	21.4			
295.5	24.3			
296.0	24.3			
296.5	25.2	77.79	7.87	9.18
297.0	25.2			
297.5	29.1			
298.0	40.1			
298.5	55.0	62.18	7.75	8.55
299.0	60.0			
299.5	60.9			
300.0	62.9			
300.5	65.8	58.01	7.38	8.82
301.0	69.8			
301.5	72.7			
302.0	73.7			
302.5	70.6	54.57	7.35	8.50
303.0	29.6			
303.5	24.5			
304.0	23.5			
304.5	22.4	71.21	7.52	7.98
305.0	20.4			
305.5	24.3			
306.0	22.3			
306.5	19.2	70.43	7.44	9.43
307.0	22.2			
307.5	24.1			
308.0	24.1			
308.5	26.0	71.21	7.31	9.82
309.0	26.0			
309.5	25.9			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
346.0	5.4				373.0	4.2				400.0	7.6			
346.5	6.4	72.85	9.29	7.25	373.5	5.2				400.5	8.6			
347.0	6.3				374.0	4.2				401.0				
347.5	6.3				374.5	4.2				401.5	7.6			
348.0	6.2				375.0	5.2				402.0	7.6			
348.5	7.2	72.54	9.42	8.17	375.5	5.2				402.5	7.6			
349.0	5.1				376.0	4.2				403.0	5.6			
349.5	7.1				376.5	3.2				403.5	7.6			
350.0	6.0				377.0	4.2				404.0	6.6			
350.5	7.0	70.02	8.89	8.48	377.5	4.2				404.5	6.7			
351.0	7.9				378.0	4.2				405.0	5.7			
351.5	4.9				378.5	4.3				405.5	6.7			
352.0	6.8				379.0	5.3				406.0	6.7			
352.5	8.8	72.80	9.50	9.17	379.5	6.3				406.5	6.7			
353.0	6.7				380.0	5.3				407.0	5.7			
353.5	6.7				380.5	5.3				407.5	7.7			
354.0	7.6				381.0	6.3				408.0	6.7			
354.5	6.6	72.50	8.33	9.32	381.5	7.3				408.5	6.7			
355.0	6.5				382.0	9.3				409.0	5.7			
355.5	7.5				382.5	11.3				409.5	6.7			
356.0	7.4				383.0	11.3				410.0	7.7			
356.5	7.4	72.22	9.22	9.22	383.5	13.3				410.5	7.7			
357.0	7.3				384.0	16.3				411.0	7.8			
357.5	8.3				384.5	14.3				411.5	6.8			
358.0	7.2				385.0	14.4				412.0	7.8			
358.5	7.2	73.48	7.71	9.87	385.5	13.4				412.5	7.8			
359.0	6.1				386.0	12.4				413.0	6.8			
359.5	5.1				386.5	12.4				413.5	5.8			
360.0	3.0				387.0	12.4				414.0	5.8			
360.5	5.0	72.99	8.22	9.64	387.5	10.4				414.5	5.8			
361.0					388.0	12.4				415.0	5.8			
361.5					388.5	11.4				415.5	5.8			
362.0	5.0				389.0	11.4				416.0	6.8			
362.5	7.0				389.5	11.4				416.5	5.8			
363.0	7.0				390.0	10.4				417.0	5.8			
363.5	6.0				390.5	11.4				417.5	5.9			
364.0	6.0				391.0	10.4				418.0	4.9			
364.5	7.0				391.5	10.5				418.5	3.9			
365.0	5.0				392.0	9.5				419.0	3.9			
365.5	5.1				392.5	9.5				419.5	3.9			
366.0	5.1				393.0	9.5				420.0	4.9			
366.5	6.1				393.5	10.5				420.5	4.9			
367.0	5.1				394.0	11.5				421.0	3.9			
367.5	5.1				394.5	10.5				421.5	4.9			
368.0	6.1				395.0	9.5				422.0	3.9			
368.5	6.1				395.5	9.5				422.5	4.9			
369.0	6.1				396.0	9.5				423.0	3.9			
369.5	6.1				396.5	9.5				423.5	4.9			
370.0	6.1				397.0	8.5				424.0	5.0			
370.5	5.1				397.5	9.6				424.5	5.0			
371.0	7.1				398.0	8.6				425.0	5.0			
371.5	5.1				398.5	9.6				425.5	5.0			
372.0	4.2				399.0	9.6				426.0	5.0			
372.5	5.2				399.5	8.6				426.5	4.0			
										427.0	5.0			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
433.0	7.0				461.5	3.0				490.0	4.0			
433.5	7.0				462.0	3.0				490.5	4.0			
434.0	5.0				462.5	3.0				491.0	4.0			
434.5	5.0				463.0	3.0				491.5	4.0			
435.0	5.0				463.5	3.0				492.0	3.0			
435.5	5.0				464.0	4.0				492.5	3.0			
436.0	6.0				464.5	4.0				493.0	4.0			
436.5	6.0				465.0	4.0				493.5	4.0			
437.0	5.0				465.5	4.0				494.0	4.0			
437.5	5.0				466.0	4.0				494.5	4.0			
438.0	5.0				466.5	4.0				495.0	4.0			
438.5	5.0				467.0	4.0				495.5	4.0			
439.0	4.0				467.5	4.0				496.0	4.0			
439.5	4.0				468.0	4.0				496.5	4.0			
440.0	5.0				468.5	4.0				497.0	4.0			
440.5	5.0				469.0	4.0				497.5	4.0			
441.0	5.0				469.5	4.0				498.0	4.0			
441.5	5.0				470.0	4.0				498.5	4.0			
442.0	4.0				470.5	4.0				499.0	3.0			
442.5	4.0				471.0	4.0				499.5	3.0			
443.0	3.0				471.5	4.0				500.0	3.0			
443.5	3.0				472.0	4.0				500.5	3.0			
444.0	4.0				472.5	4.0				501.0	4.0			
444.5	4.0				473.0	5.0				501.5	4.0			
445.0	4.0				473.5	5.0				502.0	4.0			
445.5	4.0				474.0	4.0				502.5	4.0			
446.0	4.0				474.5	4.0				503.0	4.0			
446.5	4.0				475.0	4.0				503.5	4.0			
447.0	4.0				475.5	4.0				504.0	3.0			
447.5	4.0				476.0	4.0				504.5	3.0			
448.0	5.0				476.5	4.0				505.0	0.0			
448.5	5.0				477.0	5.0				505.5	0.0			
449.0	4.0				477.5	5.0				506.0	3.0			
449.5	4.0				478.0	5.0				506.5	3.0			
450.0	4.0				478.5	5.0				507.0	2.0			
450.5	4.0				479.0	4.0				507.5	2.0			
451.0	3.0				479.5	4.0				508.0	2.0			
451.5	3.0				480.0	5.0				508.5	2.0			
452.0	3.0				480.5	5.0				509.0	2.0			
452.5	3.0				481.0	5.0				509.5	2.0			
453.0	3.0				481.5	5.0				510.0	3.0			
453.5	3.0				482.0	4.0				510.5	3.0			
454.0	3.0				482.5	4.0				511.0	2.0			
454.5	3.0				483.0	5.0				511.5	2.0			
455.0	3.0				483.5	5.0				512.0	2.0			
455.5	3.0				484.0	4.0				512.5	2.0			
456.0	4.0				484.5	4.0				513.0	0.0			
456.5	4.0				485.0	4.0				513.5	0.0			
457.0	3.0				485.5	4.0				514.0	2.0			
457.5	3.0				486.0	4.0				514.5	2.0			
458.0	3.0				486.5	4.0				515.0	2.0			
458.5	3.0				487.0	4.0				515.5	2.0			
459.0	3.0				487.5	4.0				516.0	0.0			
459.5	3.0				488.0	4.0				516.5	0.0			
460.0	3.0				488.5	4.0				517.0	1.0			
460.5	3.0				489.0	4.0				517.5	1.0			
461.0	3.0				489.5	4.0				518.0	0.0			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
518.5	0.0				547.0	0.0				575.5	2.0			
519.0	1.0				547.5	0.0				576.0	1.0			
519.5	1.0				548.0	0.0				576.5	1.0			
520.0	0.0				548.5	0.0				577.0	2.0			
520.5	0.0				549.0	0.0				577.5	2.0			
521.0	1.0				549.5	0.0				578.0	2.0			
521.5	1.0				550.0	1.0				578.5	2.0			
522.0	1.0				550.5	1.0				579.0	2.0			
522.5	1.0				551.0	0.0				579.5	2.0			
523.0	1.0				551.5	0.0				580.0	2.0			
523.5	1.0				552.0	0.0				580.5	2.0			
524.0	1.0				552.5	0.0				581.0	1.0			
524.5	1.0				553.0	0.0				581.5	1.0			
525.0	2.0				553.5	0.0				582.0	1.0			
525.5	2.0				554.0	0.0				582.5	1.0			
526.0	1.0				554.5	0.0				583.0	2.0			
526.5	1.0				555.0	0.0				583.5	2.0			
527.0	1.0				555.5	0.0				584.0	3.0			
527.5	1.0				556.0	0.0				584.5	3.0			
528.0	-1.0				556.5	0.0				585.0	1.0			
528.5	-1.0				557.0	1.0				585.5	1.0			
529.0	-1.0				557.5	1.0				586.0		72.05	8.42	9.48
529.5	-1.0				558.0	0.0				586.5				
530.0	0.0				558.5	0.0				587.0				
530.5	0.0				559.0	1.0				587.5	1.0			
531.0	-1.0				559.5	1.0				588.0	1.0	70.16	9.00	13.27
531.5	-1.0				560.0	1.0				588.5	2.0			
532.0	0.0				560.5	1.0				589.0	1.0			
532.5	0.0				561.0	1.0				589.5	2.0			
533.0	0.0				561.5	1.0				590.0	2.0	72.02	9.37	9.59
533.5	0.0				562.0	2.0				590.5	3.0			
534.0	1.0				562.5	2.0				591.0	3.0			
534.5	1.0				563.0	1.0				591.5	3.0			
535.0	0.0				563.5	1.0				592.0	3.0	69.42	8.67	11.07
535.5	0.0				564.0	2.0				592.5	3.0			
536.0	0.0				564.5	2.0				593.0	3.0			
536.5	0.0				565.0	2.0				593.5	3.0			
537.0	0.0				565.5	2.0				594.0	2.0	69.87	9.00	10.97
537.5	0.0				566.0	2.0				594.5	1.0			
538.0	0.0				566.5	2.0				595.0	2.0			
538.5	0.0				567.0	3.0				595.5	2.0			
539.0	0.0				567.5	3.0				596.0	2.0	69.21	9.06	13.92
539.5	0.0				568.0	1.0				596.5	1.0			
540.0	0.0				568.5	1.0				597.0	2.0			
540.5	0.0				569.0	2.0				597.5	3.0			
541.0	0.0				569.5	2.0				598.0	2.0	68.95	8.84	12.61
541.5	0.0				570.0	3.0				598.5	3.0			
542.0	0.0				570.5	3.0				599.0	2.0			
542.5	0.0				571.0	2.0				599.5	1.0			
543.0	0.0				571.5	2.0				600.0	2.0	67.99	9.98	13.90
543.5	0.0				572.0	2.0				600.5	3.0			
544.0	0.0				572.5	2.0				601.0	2.0			
544.5	0.0				573.0	2.0				601.5	2.0			
545.0	1.0				573.5	2.0				602.0	2.0	68.25	8.86	13.41
545.5	1.0				574.0	2.0				602.5	1.0			
546.0	0.0				574.5	2.0				603.0	2.0			
546.5	0.0				575.0	2.0				603.5	2.0			

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
604.0	1.0	69.50	9.08	12.28	632.5	2.5				661.0	4.7			
604.5	3.0				633.0	3.5				661.5	5.7			
605.0	2.0				633.5	4.4				662.0	4.7			
605.5	2.0				634.0	3.4	68.45	8.15	9.35	662.5	4.6			
606.0	2.0	65.57	7.70	13.14	634.5	3.4				663.0	4.6			
606.5	2.0				635.0	3.3				663.5	4.6			
607.0	1.0				635.5	2.3				664.0	6.5			
607.5	1.0				636.0	3.3	68.73	8.35	10.16	664.5	4.5			
608.0	2.0	67.54	7.84	13.95	636.5	2.3				665.0	5.5			
608.5	3.0				637.0	2.2				665.5	5.4			
609.0	2.0				637.5	3.2				666.0	5.4			
609.5	2.0				638.0	3.2	67.66	7.91	9.48	666.5	6.4			
610.0	1.0	66.77	7.66	12.49	638.5	3.1				667.0	6.3			
610.5	2.0				639.0	3.1				667.5	6.3			
611.0	2.0				639.5	3.1				668.0	5.3			
611.5	2.0				640.0	3.0	69.92	8.29	9.35	668.5	6.3			
612.0	2.0	68.09	7.77	10.50	640.5	2.0				669.0	6.2			
612.5	2.0				641.0	2.0				669.5	5.2			
613.0	2.0				641.5	2.9				670.0	6.2			
613.5	2.0				642.0	2.9	67.68	7.59	10.39	670.5	5.1			
614.0	2.0	66.74	7.72	10.42	642.5	1.9				671.0	6.1			
614.5	3.0				643.0	2.8				671.5	5.1			
615.0	2.0				643.5	2.8				672.0	6.0			
615.5	3.0				644.0	1.8	65.91	7.62	8.65	672.5	5.0			
616.0	4.0	68.65	7.56	8.31	644.5	1.8				673.0	5.0			
616.5	3.0				645.0	2.7				673.5	4.9			
617.0	3.0				645.5	2.7				674.0	4.9			
617.5	3.0				646.0	2.7	67.47	7.68	11.60	674.5	4.9			
618.0	3.0	65.89	7.55	9.57	646.5	2.6				675.0	4.8			
618.5	2.0				647.0	2.6				675.5	5.8			
619.0	3.0				647.5	2.6				676.0	4.8			
619.5	3.0				648.0	2.5	64.04	7.35	15.73	676.5	4.8			
620.0	4.0	66.66	7.75	9.61	648.5	3.5				677.0	5.7			
620.5	4.0				649.0	2.5				677.5	5.7			
621.0	4.0				649.5	3.4				678.0	5.7			
621.5	4.0				650.0	3.4	65.39	7.14	14.10	678.5	5.6			
622.0	3.0	65.43	7.23	10.58	650.5	3.4				679.0	4.6			
622.5					651.0	2.3				679.5	5.6			
623.0					651.5	3.3				680.0	5.5			
623.5					652.0	3.3	65.66	6.76	12.62	680.5	5.5			
624.0		65.65	7.62	11.42	652.5	3.3				681.0	4.5			
624.5	5.0				653.0	3.2				681.5	4.4			
625.0	5.0				653.5	4.2				682.0	5.4			
625.5	3.9				654.0	3.2	65.30	7.16	11.99	682.5	4.4			
626.0	3.9	66.08	7.44	12.20	654.5	3.1				683.0	5.3			
626.5	3.9				655.0	4.1				683.5	4.3			
627.0	3.8				655.5	4.1				684.0	4.3			
627.5	3.8				656.0	4.0	66.63	7.44	9.33	684.5	5.3			
628.0	2.8	68.49	7.64	8.18	656.5	4.0				685.0	5.2			
628.5	2.8				657.0	5.0				685.5	4.2			
629.0	3.7				657.5	4.9				686.0	5.2			
629.5	2.7				658.0	4.9				686.5	4.1			
630.0	2.7	66.43	7.99	8.93	658.5	3.9				687.0	5.1			
630.5	2.6				659.0	3.8				687.5	5.1			
631.0	2.6				659.5	3.8				688.0	6.0			
631.5	2.6				660.0	4.8				688.5	6.0			
632.0	2.5	67.91	8.17	12.66	660.5	4.8								

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
639.0	3.0	70.86	8.07	11.67	672.5					706.0				
639.5					673.0	5.0	62.94	8.79	9.46	706.5				
640.0					673.5					707.0	5.6	64.86	8.56	10.41
640.5					674.0					707.5				
641.0	3.8	68.80	7.67	12.01	674.5					708.0				
641.5					675.0	6.9	64.36	8.41	7.20	708.5				
642.0					675.5					709.0	4.5	64.82	8.85	9.01
642.5					676.0					709.5				
643.0	4.7	69.30	8.50	11.41	676.5					710.0				
643.5					677.0	5.8	61.23	7.83	7.51	710.5				
644.0					677.5					711.0	4.4	65.70	8.76	9.92
644.5					678.0					711.5				
645.0	3.5	67.78	8.25	9.83	678.5					712.0				
645.5					679.0	5.8	64.87	7.82	9.20	712.5				
646.0					679.5					713.0	5.3	65.54	5.90	13.51
646.5					680.0					713.5				
647.0	4.3	69.97	8.76	10.30	680.5					714.0				
647.5					681.0	5.7	65.90	7.78	6.56	714.5				
648.0					681.5					715.0	5.3	63.55	8.67	9.47
648.5					682.0					715.5				
649.0	4.1	66.50	8.08	10.06	682.5					716.0				
649.5					683.0	5.6	64.26	7.28	9.13	716.5				
650.0					683.5					717.0	5.2	66.03	5.47	12.24
650.5					684.0					717.5				
651.0	4.0	67.11	9.07	10.21	684.5					718.0				
651.5					685.0	5.5	66.60	7.68	7.38	718.5				
652.0					685.5					719.0	5.1	66.16	8.38	10.77
652.5					686.0					719.5				
653.0	4.8	66.40	8.05	11.83	686.5					720.0				
653.5					687.0	5.4	63.88	7.79	8.05	720.5				
654.0					687.5					721.0	5.0	65.97	5.96	13.53
654.5					688.0					721.5				
655.0	4.6	67.18	8.83	10.41	688.5					722.0				
655.5					689.0	4.3	64.86	7.13	11.33	722.5				
656.0					689.5					723.0	5.1	64.98	8.29	9.69
656.5					690.0					723.5				
657.0	3.5	65.75	7.83	14.36	690.5					724.0				
657.5					691.0	5.3	63.87	6.87	12.21	724.5				
658.0					691.5					725.0	4.9	65.61	7.58	11.07
658.5					692.0					725.5				
659.0	3.3	66.99	7.57	11.89	692.5					726.0				
659.5					693.0	5.2	63.49	9.02	8.95	726.5				
660.0					693.5					727.0	4.8	66.55	5.79	12.53
660.5					694.0					727.5				
661.0	3.1	67.81	8.35	10.93	694.5					728.0				
661.5					695.0	5.1	64.15	9.55	6.82	728.5				
662.0					695.5					729.0	6.6	65.09		
662.5					696.0					729.5				
663.0	4.0	63.98	11.92	8.69	696.5					730.0				
663.5					697.0	5.0	63.89	8.78	8.83	730.5				
664.0					697.5					731.0	6.4	64.12	8.48	10.80
664.5					698.0					731.5				
665.0	3.8	65.43	11.63	10.35	698.5					732.0				
665.5					699.0	4.9	63.25	8.13	11.46	732.5				
666.0					699.5					733.0	7.2	65.40	8.34	9.84
666.5					700.0					733.5				
667.0	3.6	65.14			700.5					734.0				
667.5					701.0	4.8	64.06	7.19	10.37	734.5				
668.0					701.5					735.0	7.1	65.27	8.78	10.08
668.5					702.0					735.5				
669.0	3.4	65.07	9.56	10.24	702.5					736.0				
669.5					703.0	4.8	65.31	7.08	10.63	736.5				
670.0					703.5					737.0	4.9	66.82	7.47	10.20
670.5					704.0					737.5				
671.0	3.3	63.54			704.5					738.0				
671.5					705.0	5.7	65.07	8.75	9.68	738.5				
672.0					705.5					739.0	5.7	66.27	4.67	16.55
										739.5				

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Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)	Depth (cm)	Magnetic Susceptibility	Water Content (%)	Organic Content (%)	Carbonate Content (%)
740.0					767.5					794.5				
740.5					768.0					795.0	29.0	38.74	7.79	13.67
741.0	4.6	66.25	8.05	10.95	768.5					795.5				
741.5					769.0	14.2	50.44	3.10	18.29	796.0				
742.0					769.5					796.5				
742.5					770.0					797.0	28.0	39.82	8.11	12.86
743.0	5.4	65.74	7.62	11.95	770.5					797.5				
743.5					771.0	14.0	47.50	6.87	14.07	798.0				
744.0					771.5					798.5				
744.5					772.0					799.0	28.0	39.20	8.13	12.49
745.0	5.2	64.10	6.90	13.26	772.5					799.5				
745.5					773.0	15.0	46.16	6.15	15.02	800.0				
746.0					773.5					800.5				
746.5					774.0					801.0	30.0	38.72	7.83	13.39
747.0	7.0	65.56	7.70	10.96	774.5					801.5				
747.5					775.0	14.0	46.67	7.96	12.92	802.0				
748.0					775.5					802.5				
748.5					776.0					803.0	31.0	38.20	7.26	14.20
749.0	6.9	64.87	7.68	10.81	776.5					803.5				
749.5					777.0	15.0	45.91	7.55	12.92	804.0				
750.0					777.5					804.5				
750.5					778.0					805.0	27.0	37.84	7.65	14.48
751.0	7.7	63.17	9.20	10.93	778.5					805.5				
751.5					779.0	15.0	45.86	7.18	13.36	806.0				
752.0					779.5					806.5				
752.5					780.0					807.0	28.0	38.75	8.59	13.25
753.0	6.5	64.36	6.82	14.76	780.5					807.5				
753.5					781.0	16.0	44.33	7.04	12.96	808.0				
754.0					781.5					808.5				
754.5					782.0					809.0	32.0	36.56	8.07	13.68
755.0	6.4	64.30			782.5					809.5				
755.5					783.0	18.0	43.93	7.86	12.54	810.0				
756.0					783.5					810.5				
756.5					784.0					811.0	28.0	37.61	7.94	15.07
757.0	7.2	64.61	8.43	12.01	784.5					811.5				
757.5					785.0	19.0	41.07	8.04	12.63	812.0				
758.0					785.5					812.5				
758.5					786.0					813.0	31.0	36.48	5.60	16.14
759.0	7.0	64.42	7.66	13.68	786.5					813.5				
759.5					787.0	24.0	42.88	6.90	14.38	814.0				
760.0					787.5					814.5				
760.5					788.0					815.0	31.0	37.92	5.96	14.63
761.0	7.9	63.73	8.29	12.90	788.5					815.5				
761.5					789.0	26.0	42.36	8.00	13.18	816.0				
762.0					789.5					816.5				
762.5					790.0					817.0	33.0	36.52	8.86	11.45
763.0	6.7	63.01	6.48	15.26	790.5					817.5				
763.5					791.0	32.0	41.74	8.22	13.00	818.0				
764.0					791.5					818.5				
764.5					792.0					819.0	32.0	35.94	9.96	10.35
765.0	13.5	58.20	7.86	12.89	792.5					819.5				
765.5					793.0	28.0	40.26	7.27	13.29	820.0				
766.0					793.5					820.5				
766.5					794.0					821.0	31.0	37.40	9.37	10.80
767.0	14.3	51.31	8.15	12.48										

Appendix V

Results from stable isotope analyses of ostracods from Lake Qarun.

Qaru1 ostracod stable isotope results

Sample identifier	Depth (cm)	$\delta^{13}C$	$\delta^{18}O$
Q9-10	9-10	-4.0	6.2
Q19-20	19-20	-4.5	6.4
Q29-30	29-30	-3.4	6.6
Q39-40	39-40	-3.5	6.7
Q49-50	49-50	-3.6	7.1
Q59-60	59-60	-3.1	6.9
Q69-70	69-70	-2.5	6.6
Q79-80	79-80	-2.1	6.0
Q94-95	94-95	-2.5	6.1
Q99-100	99-100	-2.6	6.4

Modern ostracod stable isotope results

Sample identifier	$\delta^{13}C$	$\delta^{18}O$
QSS1	-4.5	7.1
QSS2A	-4.0	6.6
QSS3	-4.8	7.0
QSS5	-3.8	6.8
QSS7	-4.7	6.9
QSS8	-4.9	6.6
QSS9	-3.6	7.1
QSS10	-3.7	6.3
QSS11A	-4.2	6.4
QSS15	-4.4	6.7

Appendix VI

Results from stable isotope analyses of Lake Qarun water and surface sediment samples.

Surface sediment - bulk organic analyses				
Site Number	$\delta^{13}C$	%C	%N	C/N
8	-25.8	6.2	0.7	9.0
9	-25.1	6.2	0.7	9.2
10	-25.0	3.9	0.4	9.1
11	-24.9	5.1	0.6	9.1
15	-20.6	0.8	0.1	7.5
16	-21.7	1.2	0.1	11.6

Water Samples - April 2003				
Site Number	Site location	$\delta^{18}O$	δD	$\delta^{13}C$
1	lake	7.51	47.6	-5.9
3	lake	7.69	49.0	-6.4
5	lake	7.79	49.2	-5.0
6	lake	7.72	48.6	-6.5
8	lake	7.78	48.3	-5.0
10	lake	7.76	48.2	-4.2
11	lake	7.79	48.6	-3.7
13	lake	7.81	46.7	-3.2
15	lake	6.52	42.0	-9.5
16	lake	7.73	49.4	-9.9
17	drain	3.67	28.1	-10.8
18	drain	3.55	24.6	-10.6
19	drain	3.36	27.9	-6.7

Figure 1. Map of Lake Qarun with inset showing the location of Lake Qarun within Egypt. The location of all coring sites are shown. Percussion core locations (Appendix I) are indicated by a red X. Surface sediment and water sampling sites (Appendix III) are indicated by a number, whereas gravity cores (Appendix II) are indicated by a number preceded by the letter G.

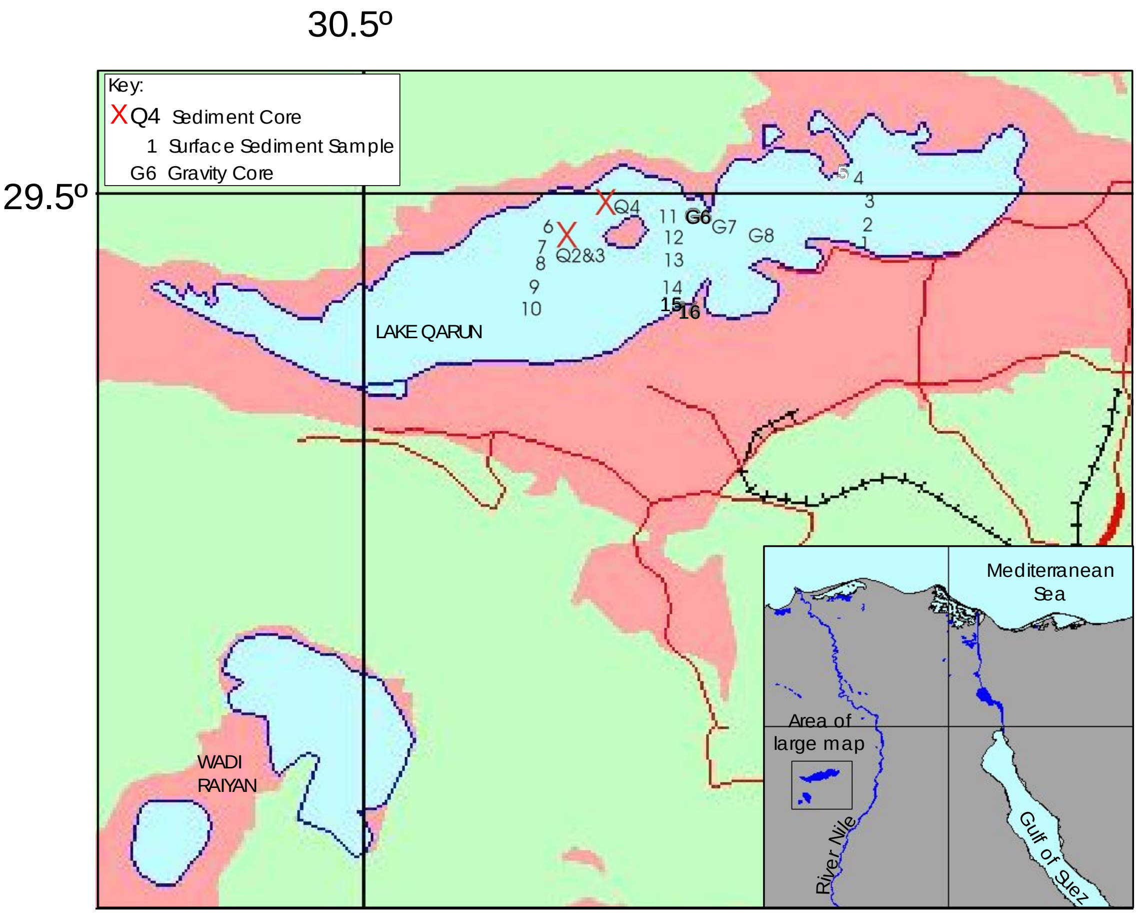

Figure 2. Photograph of plant remains at site of ancient beach deposits, providing evidence for earlier, higher levels of Lake Qarun. The photograph shows beach deposits c. 43m above the present lake level. Late Palaeolithic flint tools were found in association with these beach deposits. From Caton-Thompson & Gardener (1929).

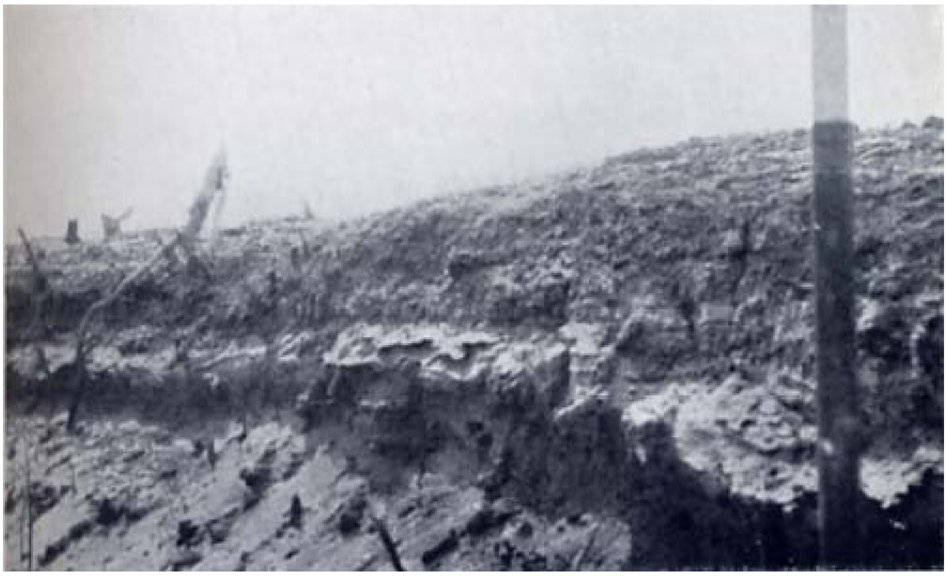

Figure 3. Work underway on the coring platform, Lake Qarun, Egypt, 13 April 2003. Photograph was taken during the extraction of core QARU 2.

Figure 4. Diagrammatic representation of the cores extracted from Lake Qarun. QARU 1 was collected in 1997; QARU 2 and 3 were collected during fieldwork in April 2003. The shaded cores were sub-sampled in the field. The remaining cores were cut into small (60 to 80cm) sections for transportation to University College London. Broken lines indicate the points at which the cores were cut and the lengths of each sub-section is shown, as well as the depth to the top and base of each drive.

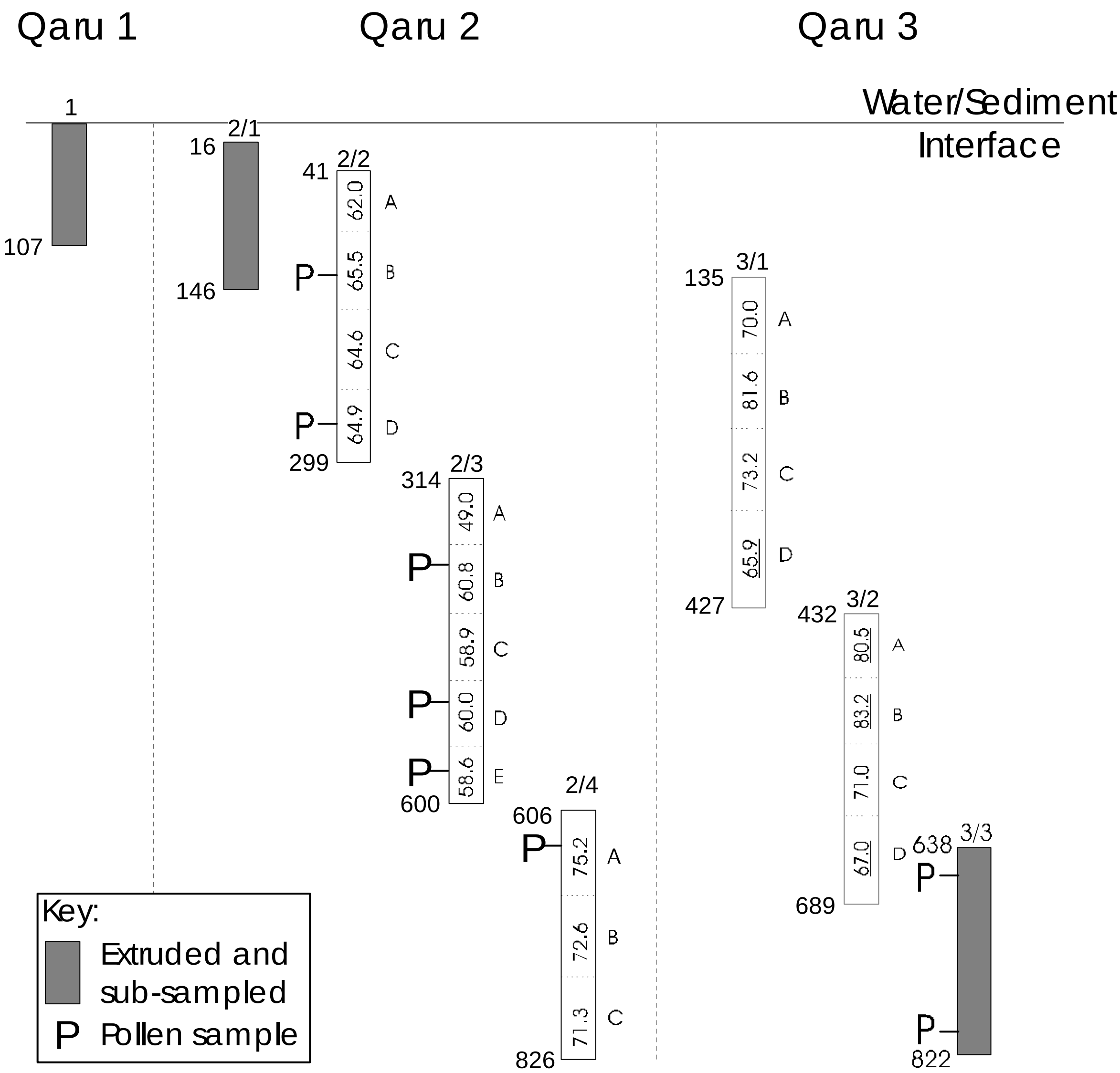

Figure 5. Calcified serpulid tubes encrusting the surface of gravity core QARU 7.

Figure 6. Photographs of sections of core showing a range of features. A. Top of QARU 2/2A showing faintly laminated sediment and bivalves. B. QARU 3/1C showing massive sedimentary units. C. QARU 3/2C, well laminated sediment. D. QARU 2/4A, well laminated sediment. E. Base of QARU 2/4C, sediment texture variation that is not accompanied by a change in lithology. Tearing of sediment during splitting can be seen in the lower part of QARU 2/4C.

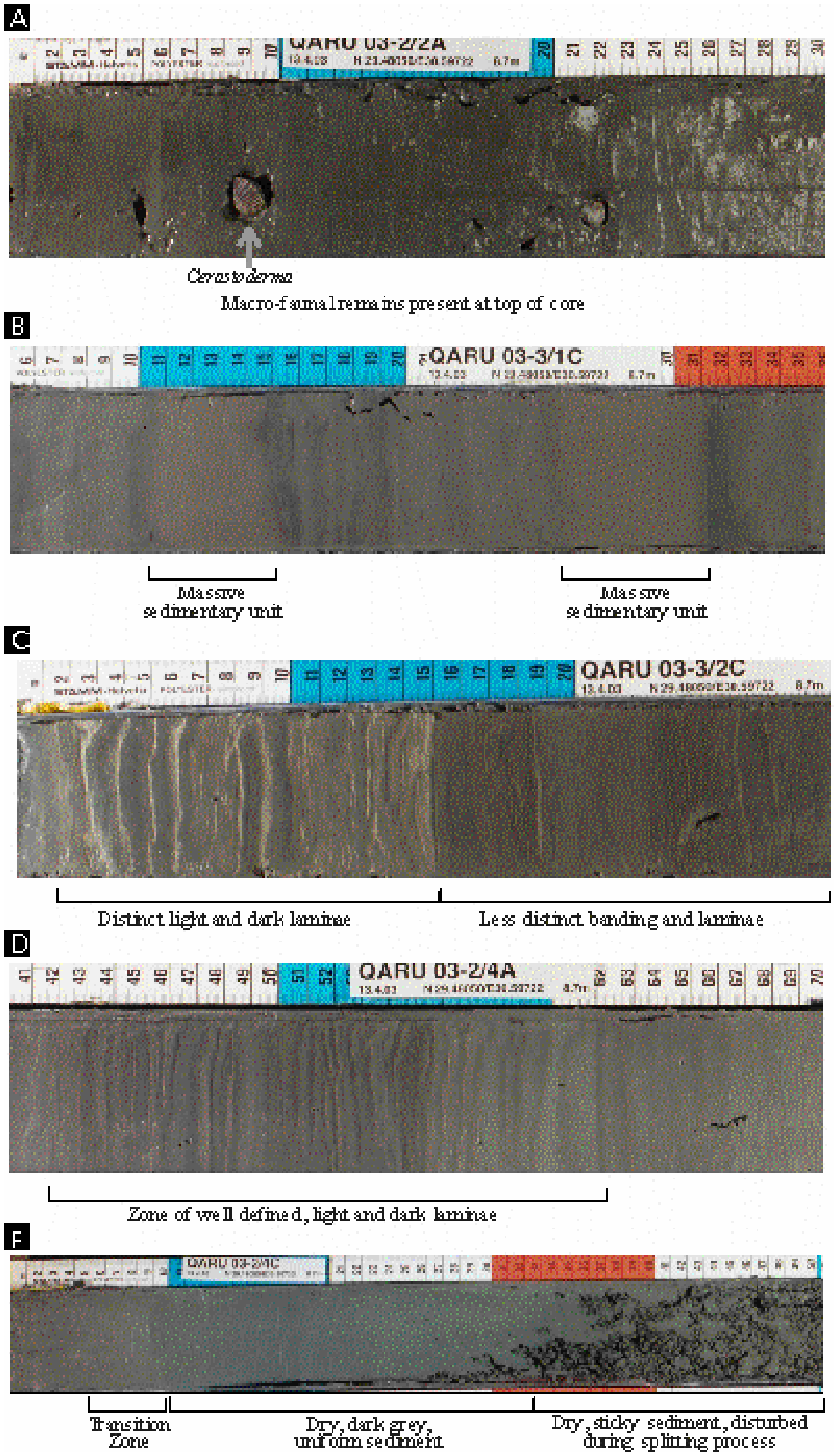

Figure 7. Diagram of core QARU 2. Shading and lines represent the colouring and the main features that are seen in the core.

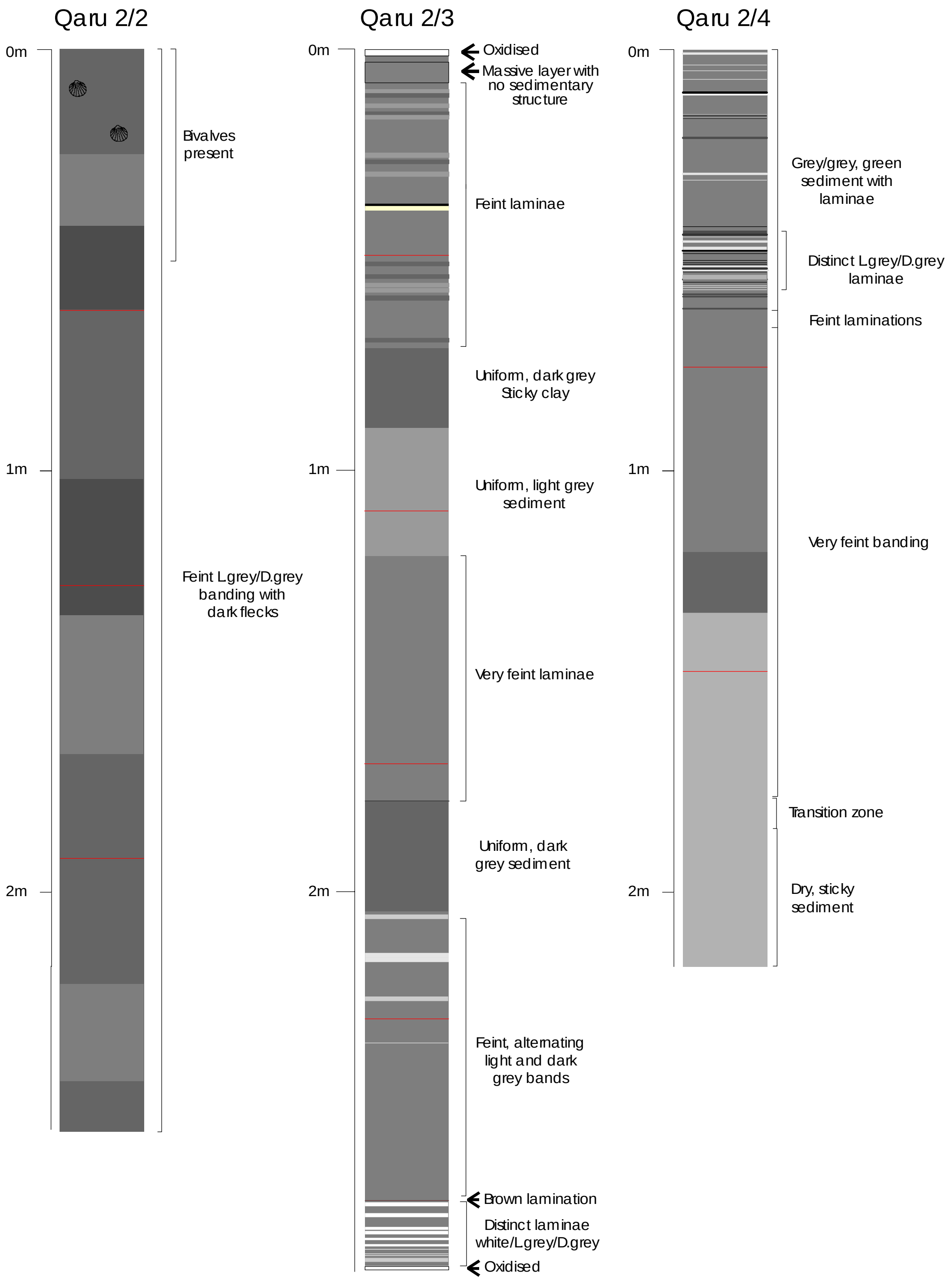

Figure 8. Scanning electron microscope images of carbonate crystals from the white and brown laminae at approximately 5.8-5.9m depth. The structure of the crystals in A, B, C, and D appears to be trigonal, suggesting that the mineral is calcite. The mineral shown in micrographs E and F has an amorphous structure.

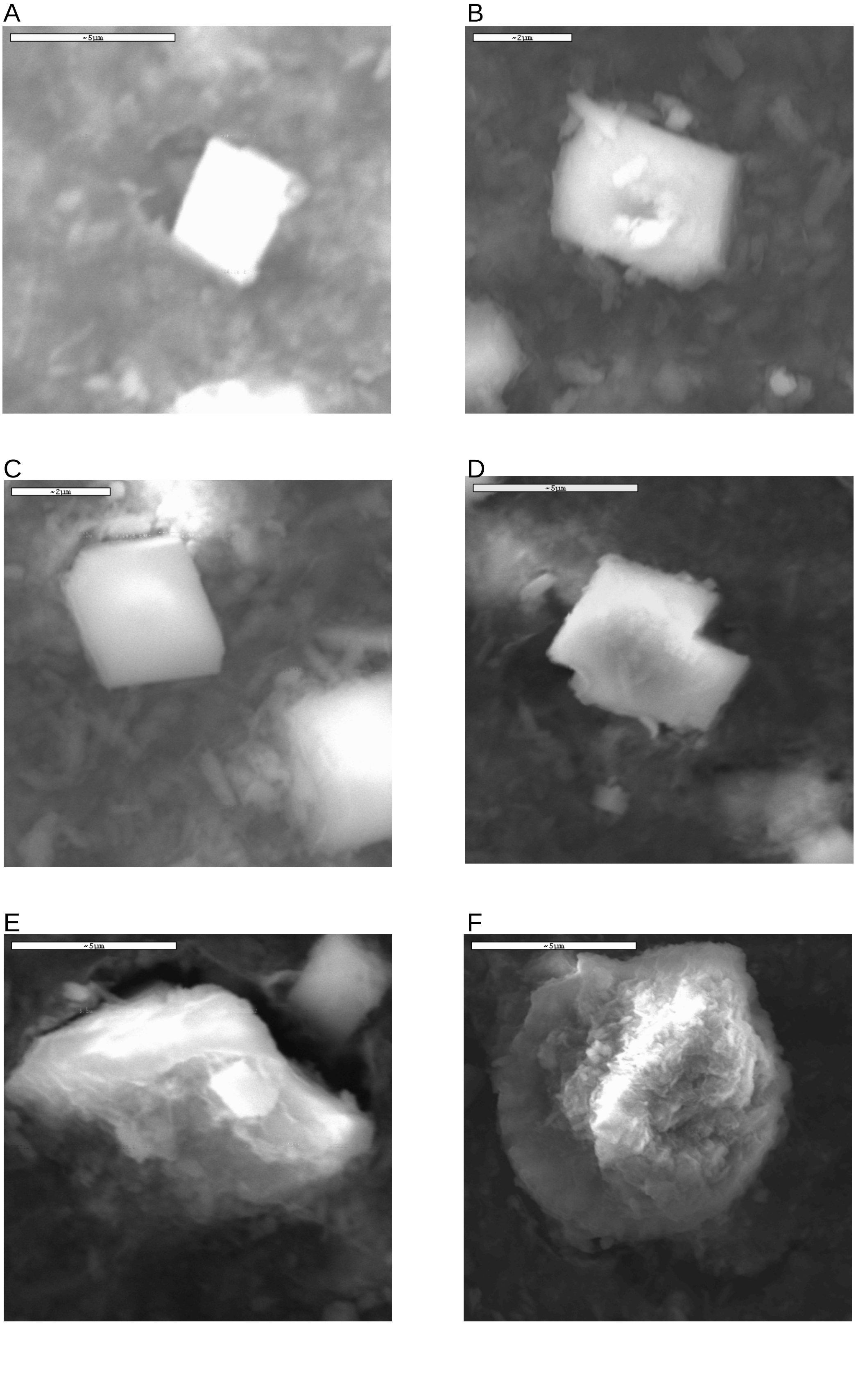

Figure 9. Diagrammatic representation of core QARU 2 together with data from magnetic susceptibility, water content and loss on ignition and carbonate content analyses. The upper 41cm section is not illustrated because this data is taken from QARU 1 and 2/1, which were extruded and sub-sampled without being split (Figure 4).

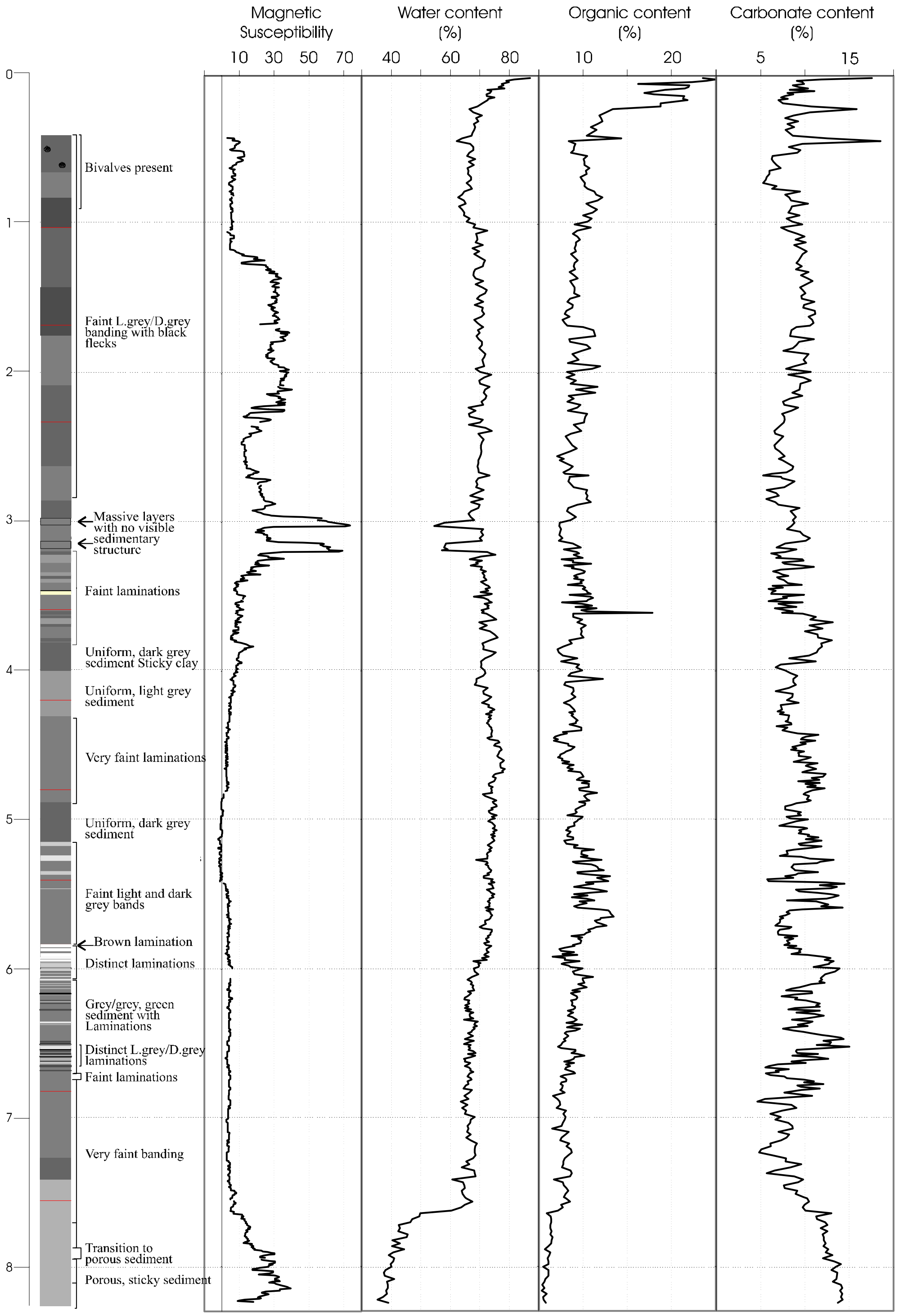

Figure 10. Volume magnetic susceptibility results for cores QARU 2 and 3. Magnetic susceptibility was one of the criteria used to cross-correlate the core sections.

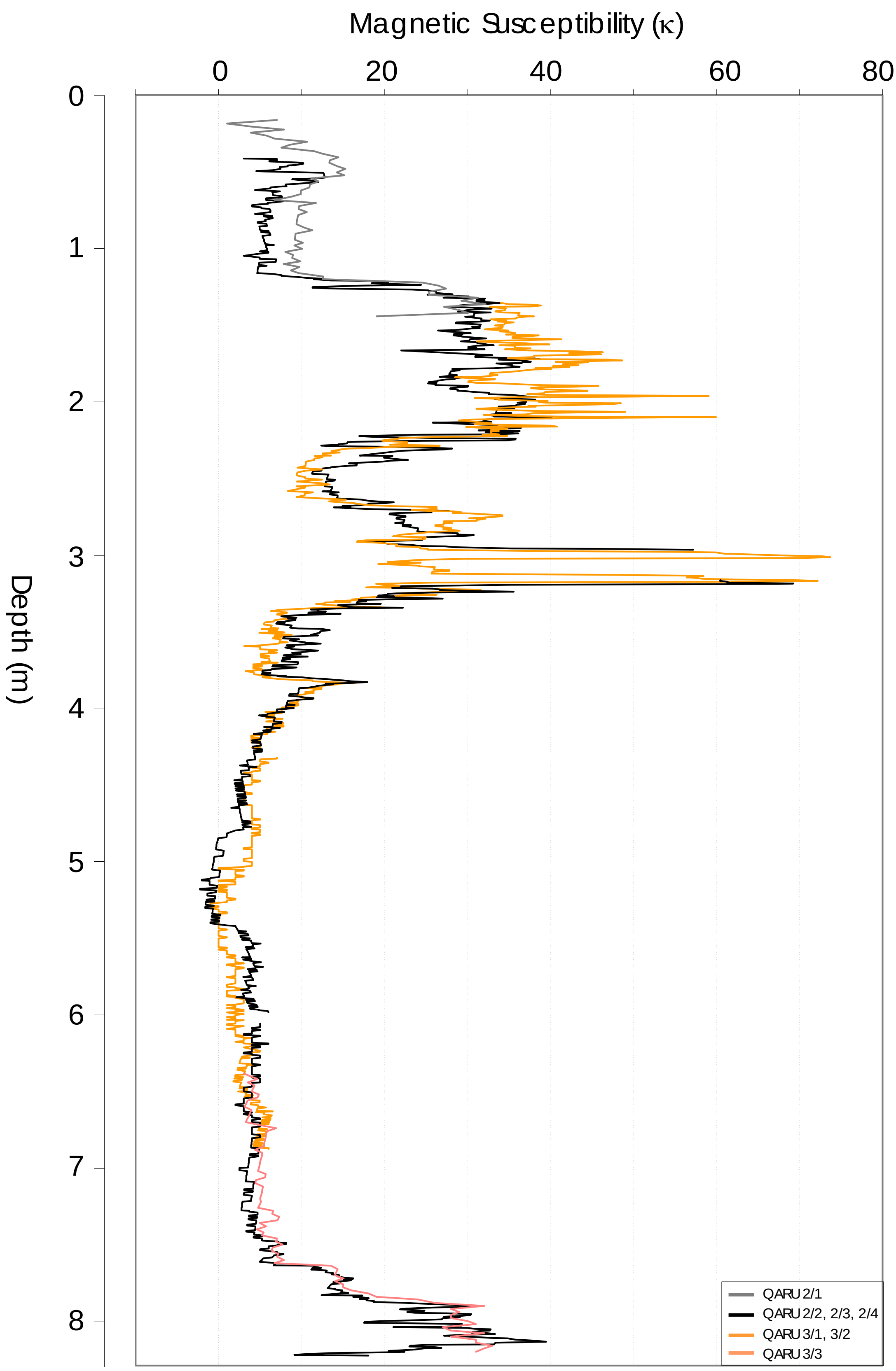

Figure 11. Water content results for QARU 1, 2, and 3. Water content was one of the criteria used to cross-correlate between core sections.