

Paleoecology of Ostracods from the Hominin Sites and Paleolakes Drilling Project's West

Turkana Kaitio core from West Turkana, Kenya

Anna Gravina

Rutgers University

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**Abstract**

Eastern Africa is ripe with early Hominin fossils and West Turkana which has one of the most famous fossils in existence, Turkana Boy. Turkana Boy perished at a lake margin which helped to preserve his bones. Because Hominins are terrestrial, fossils similar to Turkana Boy are not found very often and, in fact, the depositional area of the lake margin supported fossilization. Ostracods from the core are contemporaries to this Hominin and due to the abundance of these creatures in the core, it is possible to use them as a part of the puzzle for finding evidence of environmental conditions. This honor's thesis focuses on the paleoecology of Ostracods from a core from the Hominin Sites and Paleolakes Drilling Project, HSPDP, taken from West Turkana, Kenya, next to Lake Turkana. The comparison of the geological and paleontological findings from this core to current knowledge of outcrop studies help to better date and find paleoecological data.

**Paleoecology of Ostracods from the Nattoo and Kaitio Members of the Nachukui  
formation from West Turkana, Kenya**

**Literary Review**

The East African Rift System is extremely important to the formation of the Turkana-Omo Basin, other basins, and lakes of the region. The African plate is being slowly rifted at 7 mm per year into the Nubian plate, in the northwest, and the Somalian plate, to the southeast (Fernandes et al., 2004). The rifting of the African continent is caused by weakening of the crust from stretching, intrusive heating, and a dynamic asthenosphere. This rifting creates several separate but kinematically related basins that can have expressions of magmatism. These basins form grabens which are basins that have two normal separation faults with a center block that drops down and creates a lowland area and two flanking highlands. Faulting and magmatism have been found to be synchronous (Ebinger, 2005).

The East African Rift System consists of 2 main rift valleys with a smaller southern rift. The two main rifts are the eastern branch and the western branch. The western branch runs 2100 km from Lake Albert (Mobutu) to Lake Malawi. The eastern branch runs 2200 km from the Afar triangle south down to the north Tanzania divergence. This eastern branch, also known as the Main Ethiopian Rift, will be the focus area of this study. The smaller southern rift is in the Mozambique channel (Chorowicz, 2005).

The Main Ethiopian Rift has five main areas that make up this rift. The most northern area is the Afar triangle. The next region is the Ethiopian rift region. The rift floor is about 50 km across with the length being 330 km long. The region consists of asymmetrical grabens that dip east and the fault lying east. The next southern section is the Omo-Turkana lowlands which is the area of study. The Omo-Turkana lowlands, also known as the Turkana Basin, have

elevations less than 400 m. Several N to NE striking half-grabens, a basin that forms from sediment accumulating on the hanging wall block of the normal fault. No pronounced rift or shoulder is present. Sediments that deposited in the half-graben are from the late Cenozoic to the Quaternary that are up to 7 kilometers thick (Chorowicz, 2005).

Three main formations are around Lake Turkana: the Shungura formation, the Nachukui formation, and the Koobi Fora formation.

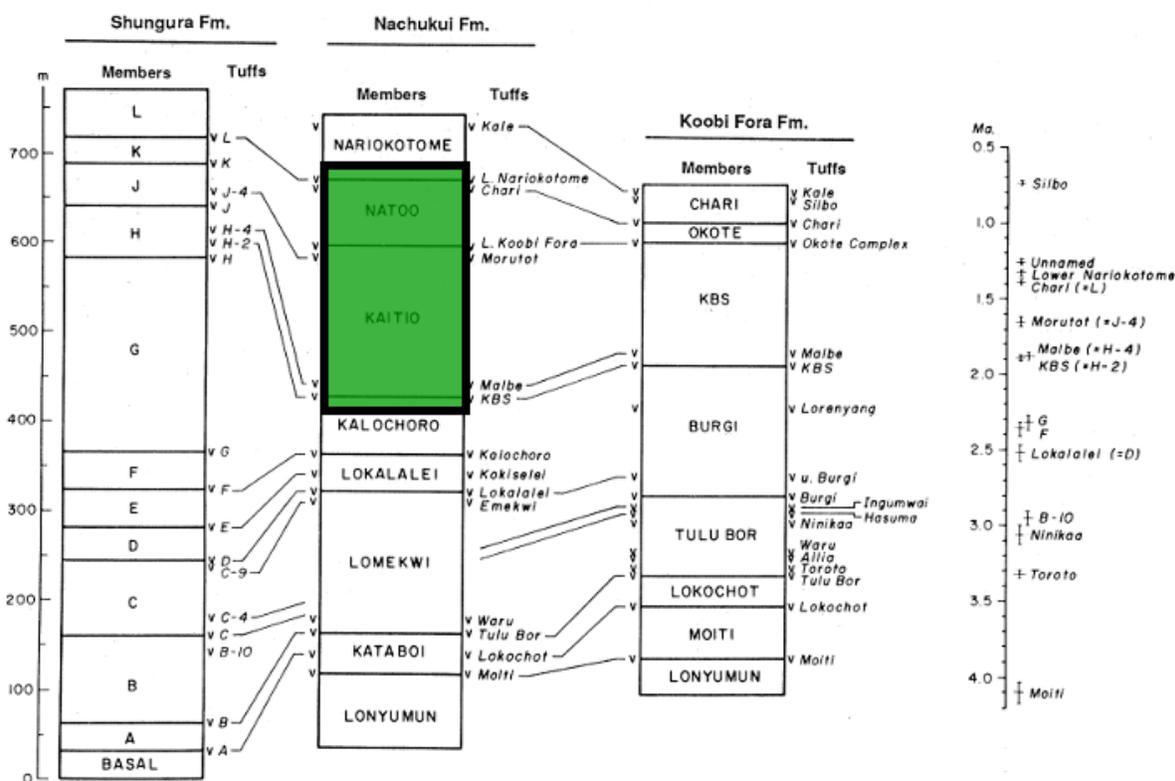


Figure 1. Correlations of the Shungura, Nachukui, and Koobi Fora formations with green highlighted portion being the section that the HSPDP-WTK13 core spans (modified from Harris et al. 1988)

The locations of the formation are proximal to Lake Turkana; Shungura being northern, in the Lower Omo Valley, Koobi Fora being eastern, and Nachukui being west of the lake (Harris, Brown, Leakey, M., Walker, & Leakey, R. (1988). Strata from these formations are lacustrine or fluvial in origin with various volcanic events throughout.

The sediment post Pliocene was accumulated as the Turkana Basin became the modern, large depositional system that it is today. This modern system consists of a series of several lakes with intermittent floodplains. Lake Lonyumun was the first lake to form in this system at 4.1 Ma. The lake was the largest of the Plio-Pleistocene lakes and filled the basin with 120 m of sediment.

Lonyumun deposited sediment at such a fast pace in the basin that the subsidence of the basin could not catch up. This led up to the formation of the Moti floodplain which was subsequently replaced by the Lokochot Lake. The Lokochot Lake was largely shallow and had a lifespan of approx. 60 ky. The next phase is the Tulu Bor Floodplain. This is one of the longest lived floodplain.

The Tulu Bor also has two small minor lakes within the phase, the Waru and the Kokiselei. The end of this phase had the beginnings of the Hamar Uplift and the formation of the Mt. Kulal, the second which could have contributed to the development of Lake Lorenyang, the longest lake phase of the Turkana Basin. Instead of a steady deep lake phase, this lake fluctuated extremely and manifested as a complex, shifting landscape.

The next couple of phases in this sequence are very short; the transition was from the Lorenyang Lake to the Chari Floodplain to the Nachukui Lake to the Silbo Floodplain. The end of the Silbo Floodplain is marked with an unconformity at 700 ka and the next time of deposition thereafter was the modern Lake Turkana at 200 ka (Feibel, 2011).

The Shungura, Koobi Fora, and Nachukui formations are all areas that had early Hominin fossils. The site for the core was taken from the Nachukui formation which is rich in early Hominin fossils, such as: Kenyanthropus, Paranthropus, and Homo erectus (Leaky et al., 2001; Reed, 1997). The Nattoo member of the Nachukui was targeted for drilling by the HSPDP team

because this member is famous for the *Homo erectus* skeleton, named Turkana boy. This member is thought to represent marshy wetland with wooded and edaphic grasslands. Dated between 3.6 Ma and 1.0 Ma, the Shungura formation had early hominins found in it too, such as *Australopithecus* and *Paranthropus aethiopicus*. Paleoanthropologists found that *Australopithecus* lived in perennial river with flooding and closed woodland with riverine forest and that *Paranthropus* lived in bushland-woodland with riverine forest and edaphic grasslands. The Koobi Fora formation is known to have been the site of many Hominin fossils, such as: *Paranthropus boisei*, *Homo rudolfensis*, *Homo ergaster*, and *Homo erectus*. Paleoanthropologists found *Paranthropus boisei* in the Okote formation which is correlated to the Nataroo member, where the Turkana boy was found, which is also thought to be wetlands and edaphic grasslands, the same paleoenvironmental interpretation as the Nataroo member (Reed, 1997).

Paleoenvironmental reconstruction of an area such as West Turkana can be complicated. While the prospect of finding large vertebrate or Hominin fossils is exciting, the amount of information is limited from these fossils and the physical amount of those fossils are small. Using other proxies such as invertebrates, i.e. ostracods, as a piece of the puzzle for paleoecology and paleoenvironmental reconstructions can help fill in gaps of scientific knowledge.

Ostracods are a class of crustaceans that are covered with two calcite valves, or shells, with five to eight segmented appendages (see figure 3). Valves are usually reniform, kidney, or ovate-shaped with a length that varies usually between between 2.0 mm to 0.5 mm. Ostracods live in the most diverse amount of environments. If an area has moisture, it is likely that these creatures are existing there. Environments of Ostracods are marine, non-marine, and sub-

terrestrial; the last of which is very rare. Ostracods can be benthic, bottom dwelling, or pelagic, free swimming (Horne, Cohen, & Martens, 2002).

Lacustrine and marine sediments often hold the fossils of Ostracods. The abundance of Ostracods, when they are present, usually mean that they can be a useful tool for scientists. The calcitic valves preserve the ratio of Oxygen isotopes and radioactive Carbon from ancient atmospheres. Scientists use this useful data to find global climate and dates of the sediment.

The field of Ostracodology is in disarray. Because the original literature was written in the 1800's, there are limitations of usefulness on these papers. Scanning Electron Microscopes or SEM, a device that can capture very clear images from small objects, were not invented yet. Thorough papers on Ostracods have several of these SEM pictures. Before these devices, scientists would diagram the Ostracods. Because freshwater Ostracods are often very similarly shaped, especially within one genus, the usefulness of each paper depends on the scientists artistic ability. Many Ostracodologists do not publish Scanning Electron Microscope pictures and in fact, only describe the shape and specific morphologic criteria for a species. This causes potentially one species being named several times over the course of years or decades. It is conceivable that one who is new to the field could look at the original or older literature and misname an Ostracod by species or genus.

Ostracods are made up of a hard exterior shell and softer interior appendages. The hard parts are the bivalved shells, called the carapace. The carapace is composed of calcite with a cuticle of chitin covering the valves in life. The soft interior includes everything inside the two shells including the body and appendages. The carapace is the most commonly fossilized part of ostracods. The ostracods' carapace completely covers the body. The valves are not symmetrical and one overlaps the other. Because they are not symmetrical, it is possible to find if the valve in

question is “left” or “right”. The valves have canals, or holes, that pierce the shell. There are three types of canals: simple, sieve pore, and exocrine pores. Simple and sieve pores have sensory hairs that go through the valve to the environment. Exocrine pores do not have sensory hairs but are related to moulting. A depression in the center of the valve is called the sulcus, which can help show which valve the one being studied is, left or right (Horne et al., 2002)

An Ostracod’s genus and species is diagnostically shown from the morphology of the valves. Generally, the valves are shaped like beans but, have slight variations. General shapes that are common are: spheroidal, elongate, inflated, compressed laterally, compressed vertically, triangular, rectangular, or kidney-shaped. Surfaces of the valves can vary between genera, species, and within the same species. Valves can be flattened or ornamented, which includes: pits, larger depressions, patterns of reticulation, ridges, spines, tubercules, and nodes (Horne et al., 2002).

Appendages of Ostracods can range in number from five to a maximum of eight. The first and second appendages are the antennula and the antenna, respectively, which are used for touch and sensory experiences. The third and fourth appendages are the mandible and the maxillula. Ostracods use both of these appendages combs for feeding. The fifth through seventh limbs are usually walking limb but, can be used for feeding, respiration, and clasping. The eighth limb is only present in males that is related to reproduction. The ninth limb is called the furca (Horne et al., 2002).

The environment that Ostracods live in are extremely varied. These animals can live almost anywhere in water. In fact, they have been known to infest fish tanks. Ostracods can live in marine settings, non-marine settings, and brackish settings (see figures 5 and 6). In marine settings, they can inhabit various parts of the ocean. Parts of the ocean that they can inhabit are

the continental shelf, continental slope, continental rise, pelagic zone, and abyssal plain. These marine settings are very high in saline but, have a high stability over time regarding changes in environmental conditions. Brackish waters are where ocean waters meet fresh water, such as: estuaries, lagoons, and marginal seas. The salinity varies daily and is tide dependent. Non-marine settings are continental waters that have lower salinity than marine water. Examples of non-marine waters would include tectonically formed lakes, temporary lakes, rivers, groundwater, and saline lakes. Most freshwater sources vary geologically and chemically. Contrarily, tectonically formed lakes and groundwater are very stable geologically and are fairly chemically stable (Smith & Horne, 2002).

### Methods

The core taken for this project is one of several cores for the Hominin Sites and Palaeolake Drilling Project, HSPDP. This project aspires to provide more concrete dating for Hominin fossils in east Africa and a more complete, continuous local record of paleoenvironment from each core site. To date four cores have been drilled in this area: Northern Awash, Chew Bahir, West Turkana, and Tugen Hills.

A 216 meter core was drilled 5 kilometers south of the village Nariokotome, West Turkana, Kenya. The core was drilled June 2013. GPS coordinates of the core hole is latitude: 4.109722 degrees and longitude: 35.871781 degrees. The scientific team planned the core to be much longer but, the team ceased drilling early due to aquifer issues and mud pressure problems.

The National Lacustrine Core Facility, LacCore, at the University of Minnesota stores the core in refrigerated rooms and facilitated the sampling parties. The parties sampled for several days at the University of Minnesota for tephra, diatoms, phytoliths, XRD, TIC/TOC, Sr Isotopes, and Ostracods in addition to performing the initial core description. The LacCore facility took high resolution images of each section of the core and scanned the core for gamma density and magnetic susceptibility using a Geotek Multi-sensor core logger. The teams sampled for ostracods once every 32 cm with opportunistic samples taken when ostracod sands were visibly spotted or through smear slide.

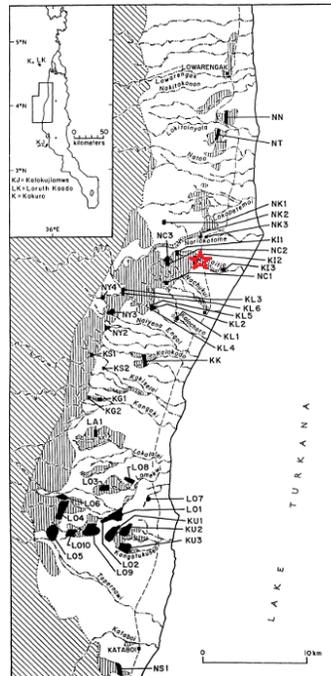
LacCore personnel shipped the Ostracod samples to the Paleoenvironmental Reconstruction Laboratory at Rutgers University, New Jersey. We recorded weights initially and after freeze-drying the samples. We made a first screening of the core which was 1 out of every 10 samples which is once every 10 meters in the core. The samples initially washed were the opportunistic and first screening samples. Before washing, we made smear slides of each sample.

First screening and opportunistic samples soaked for 12 to 24 hours before we washed them. Because opportunistic samples are much larger than the rest of the samples, the opportunistic samples were weighed out to an approximate average weight of 3.5 g and then soaked while first screening samples were completely used. We then placed the soaked sample into nested sieve that are Tyler Equivalent of 35, 60, and 120 in that respective order from top to bottom. The team washed the samples with deionized water until the majority of loose material falls through. If significant amounts of clays did not wash through, the samples were re-washed until the clays were disaggregated or to a maximum amount of 3 re-washings.

The picking protocol is to first pick the Tyler Equivalent 60 split. If that split had more than 300 ostracods, the team would be done with sampling but, note the genera of the other splits. If the Tyler Equivalent 60 had less than 300 ostracods, the 35 split would be picked and then the 120 split. A master spreadsheet was compiled on google docs that is shared in the lab to record ostracod genera found, presence of charcoal, presence of fish bone, and presence of pyrite.

## Core Background

The West Turkana Kaitio 2013 core of the Hominin Sites and Paleolakes Drilling Project



was taken from the Nachukui formation of West Turkana, Kenya (see figure 2). The core is Figure 2. Location of West Turkana core (red star) near shore of Turkana Lake (modified from Harris et al. 1988) believed to span from the upper Kalochoro member to the lower Nariokotome member as seen in figure 1. The bottom most facies have dark, brown-green deep lacustrine sediments which is associated with Kalochoro member and the Lorenyang Lake. The upper boundary of the Kalochoro and the end of the Lorenyang Lake is capped with the KBS tuff, dated at 1.87 Ma. An altered bentonite with no dateable minerals or minerals with an identifiable geochemical signature is at drive 72Q which is thought to be an altered form of the KBS tuff because it is sufficiently low in the core and is close to the end of the deep lake phase seen at the bottom of the core. Next in the sequence is the Kaitio formation, a greenish lacustrine phase. The upper boundary of the Kaitio has not been found in this core yet. Even with the trouble finding the tuff

that corresponds to the end of the Kaitio, the end of the Olduvai subchron, a magnetic reversal, has been found at around drive 62Q and an un-named tuff at 20Q has been dated to 1.42 Ma.

The boundary between the Kaitio and Natoo formations is in between these two markers. The Natoo is a largely brown package of clays and silts. The boundary between the Nariokotome and the Natoo is defined by the Chari Tuff at drive 4Q-2. Because there was little recovery of drive 1Q through 3Q, the amount of Nariokotome that is undisturbed is very small (Feibel, 2015).

## Discussion

### Genera

After analyzing the opportunistic samples and a few from the first screening, the core yielded 7 different genera total: *Hemicypris*, *Ilyocypris*, *Cyprideis*, *Sclerocypris*, *Potamocypris*, and *Darwinula*. Some genera in this core have species that have either not been identified before or identified in this area. Juveniles, that have been identified with a corresponding genus and that are unidentified, are not considered in this analysis because they are neither abundant nor common in most samples.

#### *Hemicypris.*

This genus of ostracod is most common at the bottom of the core but is found throughout. There is some debate as to assignment of *Hemicypris*. According to Sars (1903), *Hemicypris* is similar to the genus *Cypritonus* but with the right valve overlapping the left. In this study, the nature of overlap will be ignored and all ostracods that are identified as *Cypritonus* will be lumped in with the *Hemicypris*. Brady and Norman (1889) describes *Cypritonus*, what the writer calls *Hemicypris*, as sub triangular, having a convex dorsum, being subangulate medially, having a smooth surface, and narrow inner lamellae as seen in figure 3.

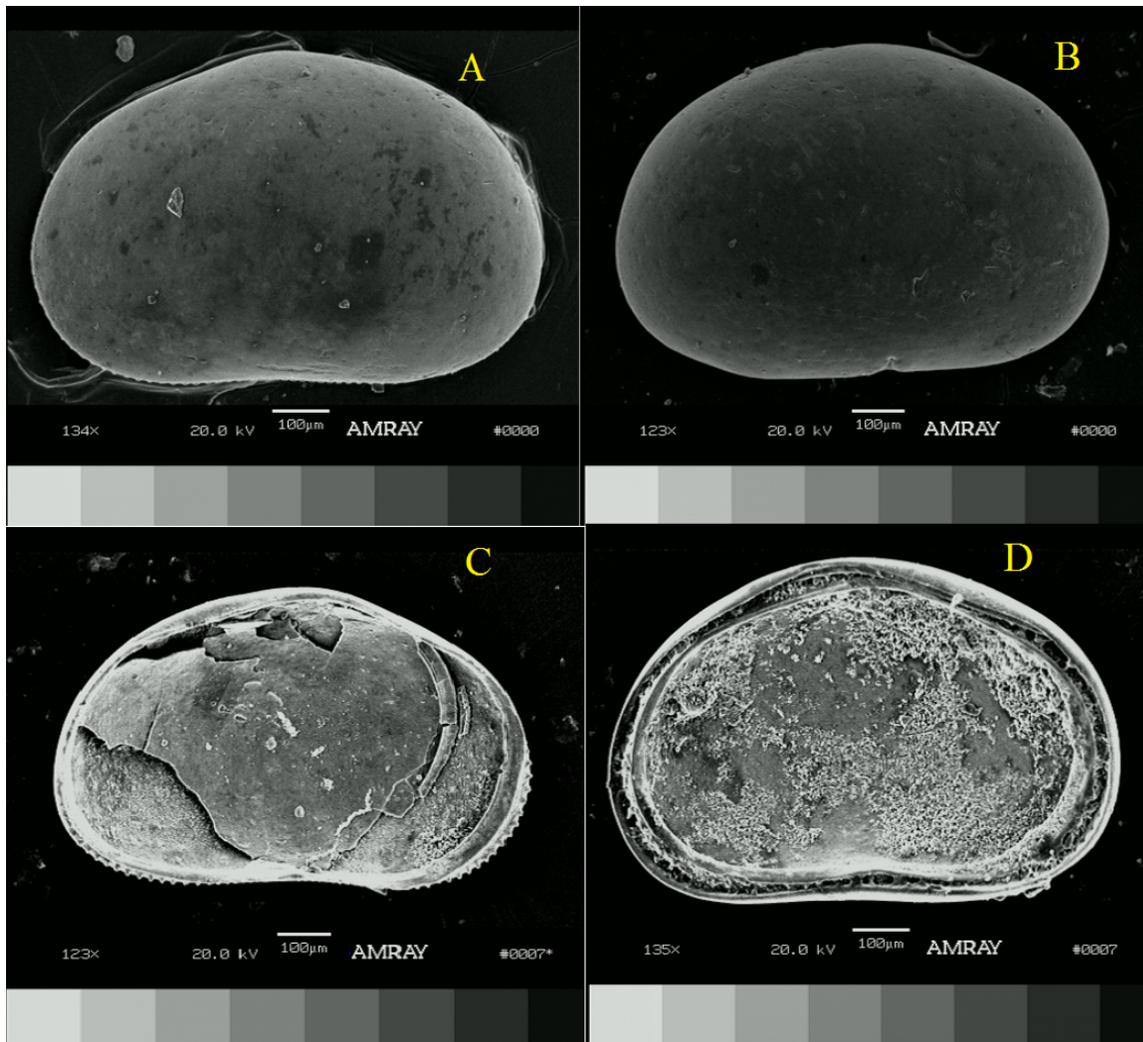


Figure 3. *Hemicypris sp 1.*; A: Exterior view, left valve, B: Exterior view, right valve, C: Interior view, left valve, denticulated, D: interior view, left valve

### **species 1.**

Species 1 is the classic form of a *Hemicypris* that is often seen in the modern sediment. This species has been seen to have denticulation, little spikes, on the lower posterior and anterior edge (Figure 3 C).

### ***species 2.***

*Hemicypris sp. 2* is more sub-triangular with a flat portion of the posterior that meets the curved dorsal and ventral portions very sharply and create angulate interceptions (figure 4). This species was very common in the lower portion of the core.

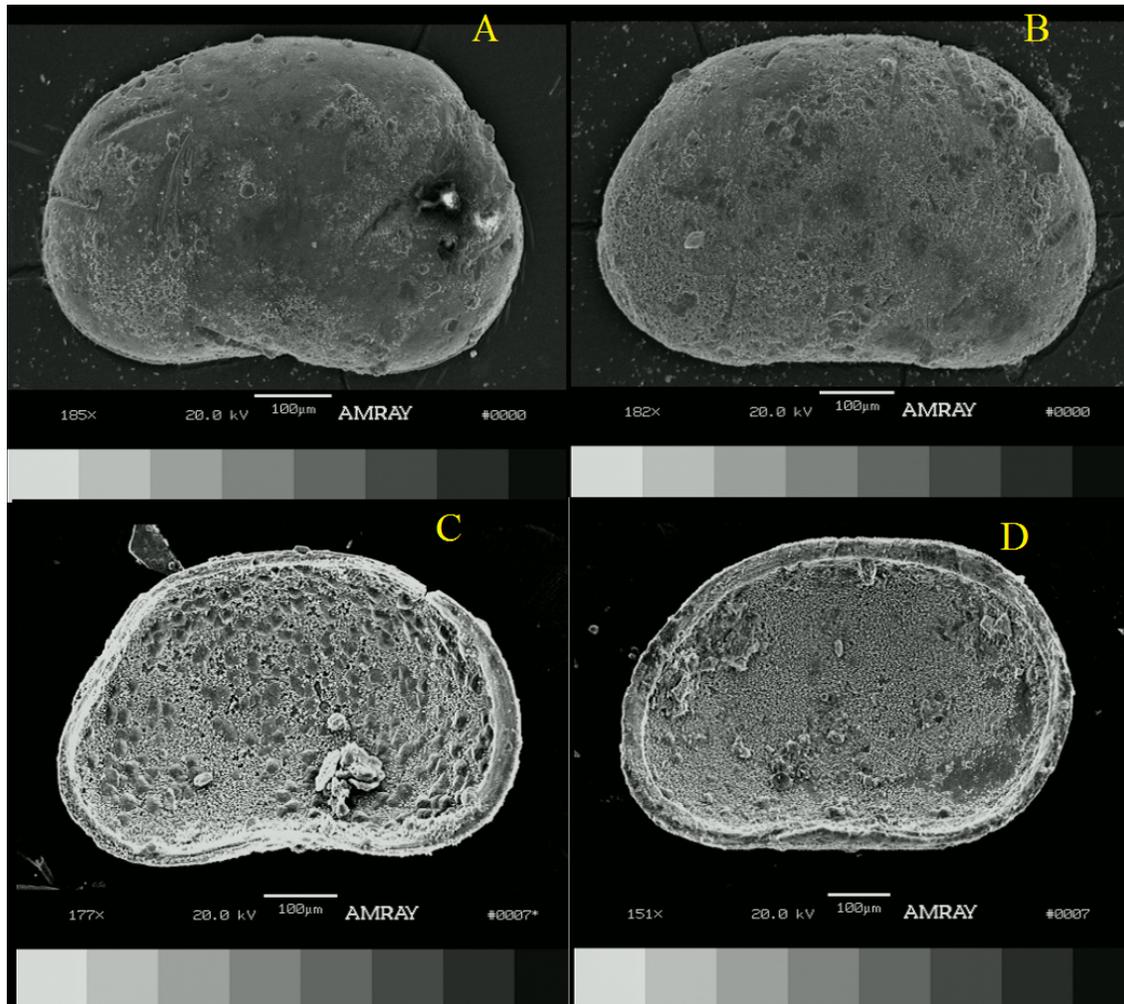


Figure 4. *Hemicypris sp.2*: A: exterior view, left valve, B: exterior view, right valve, C: interior view, left valve, D: interior view, right valve

***species x.***

Species x of *Hemicypris* is the garbage can term that if one of the pickers did not feel comfortable distinguishing between either species or if the sample was picked before species 2 was discovered. In any case if the *Hemicypris* is from a sample from the top to mid-bottom of

the core, it is most likely from species 1 while if it was from the very bottom of the core there is a mixed assemblage of species 1 and 2.

*Ilyocypris gibba.*

*Ilyocypris* is a common player in the assemblages throughout the core. While this ostracod is not the most or second most abundant except in a few samples, it is steadily found throughout the core. The only species that is found is *Ilyocypris gibba*. Brandy and Norman (1889) describes *Ilyocypris* as elongated, sub-quadrate, compressed, and bi-sulcate with surface pitting, pustulose, or tuberculate (figure 5).

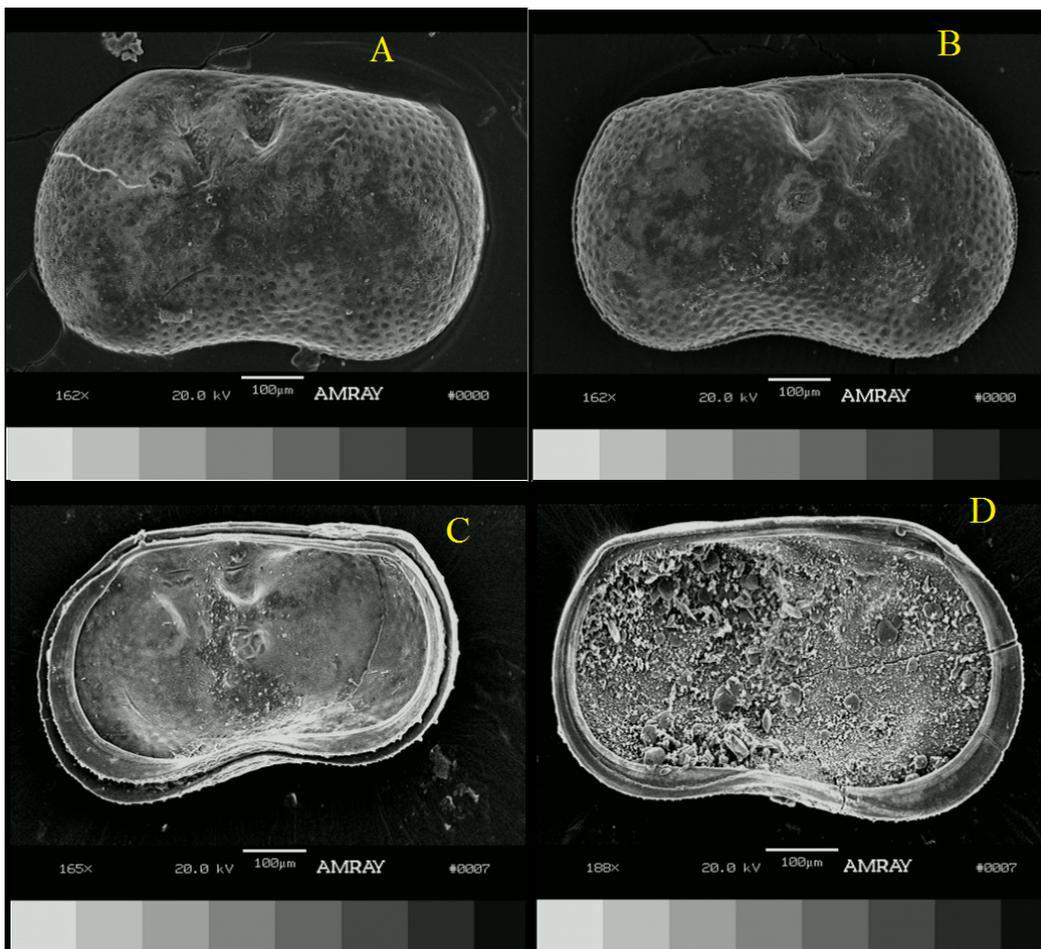


Figure 5. *Ilyocypris gibba*; A: Exterior view, left valve, B: Exterior view, right valve, C: Interior view, right valve,

D: Interior view, left valve

*Cyprideis*.

This genus of ostracod is the most common and the most abundant through most of the core which it is the most abundant in the top to mid-bottom. *Cyprideis* is mainly identified from its fairly straight hinge line and elongated carapace (Figure 6). Jones (1850) states that sexual dimorphism is extremely pronounced, it has straight radial canals, and has distinctive 4 vertical adductor muscle scars.

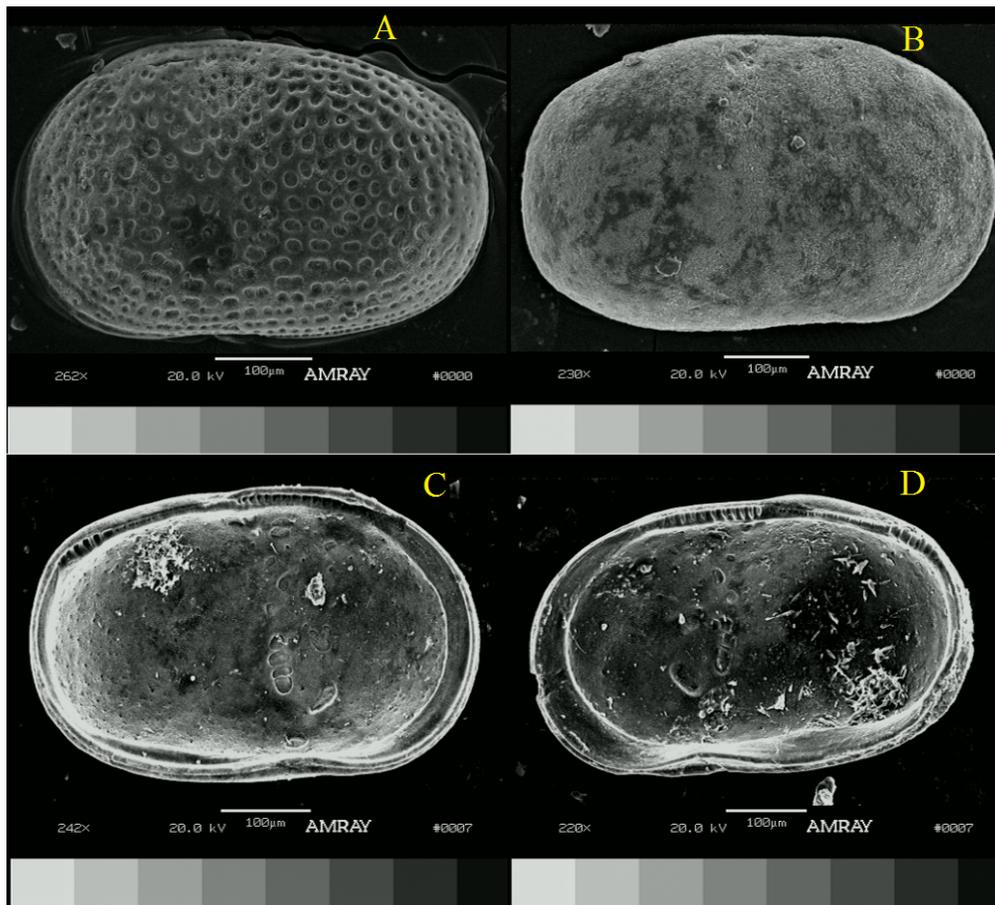


Figure 6. *Cyprideis* sp. A; A: Exterior view, left valve, with reticulation, B: Exterior view, right valve, C: Interior view, left valve, D: Interior view, right valve

*species a.*

In the WTK13 core, this species is the most common of *Cyprideis* and is the species that is found in the modern lake. Sexual dimorphism is pronounced. Females are more rounded and

“bean-shaped” while males are more thin with a pinched dorsal end (Jones, 1850). The carapace can be either reticulated or smooth (Figure 6 A and B).

***species b.***

*Cyprideis sp. B* is a species that is not documented in modern Lake Turkana. This species is much more elongated with a small ledge on the posterior end of the ventral edge (Figure 7). This questionable species is hard to interpret because the shape is dissimilar enough to be distinguishable from species A but similar enough to be questionable about being a strange shaped male version of species A. As of now, this *Cyprideis* form will be considered as a separate species.

***species x.***

The species X of *Cyprideis* is also used for when pickers are not comfortable making a distinction between either species type. There are intermediate types that are in between species A and species B and this is why this category was created.

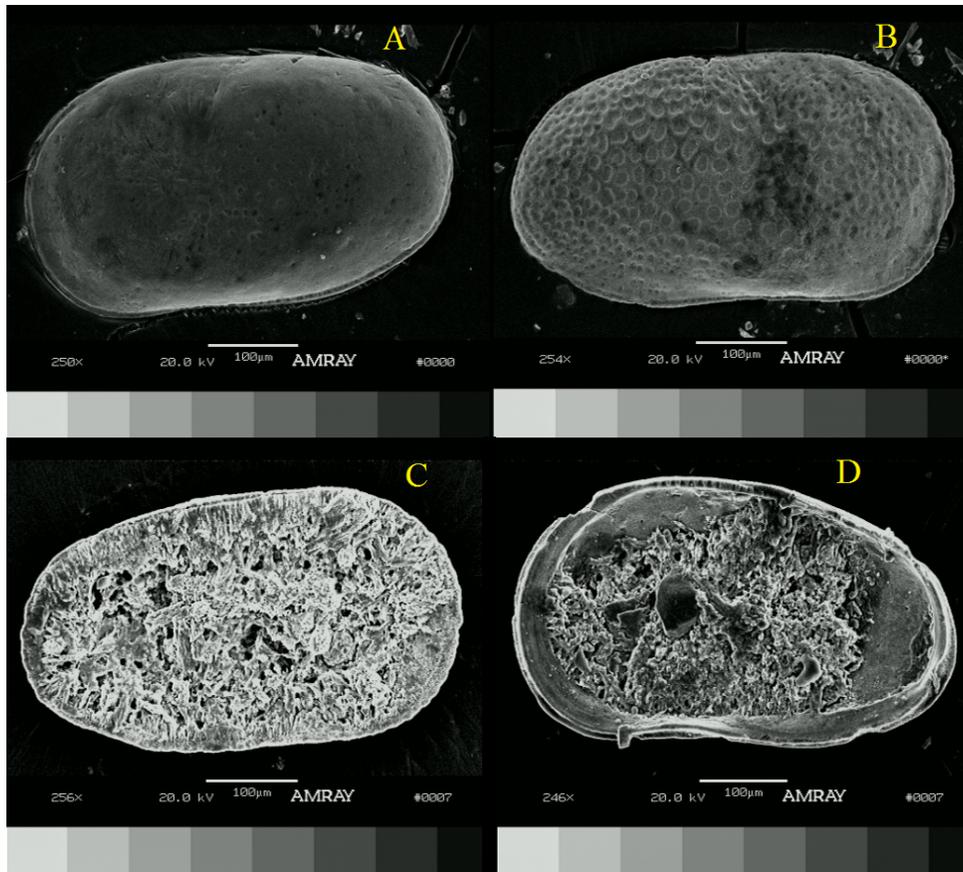


Figure 7. *Cyprideis* sp. B; A: Exterior view, left valve, B: Exterior view, right valve, C: Interior view, left valve, extremely recalcified, D: Interior view, right valve

### *Sclerocypris* spp.

This genus is not very common throughout the core but, is found. This genus is found in generally samples of greater preservation. The main distinguishing characteristic of the *Sclerocypris* is its large size which is large sand grain size, approx. 2mm. This ostracod is the largest ostracod found in Turkana and one of the biggest in general. Sars (1924) describes *Sclerocypris* as large, subquadrate, with a straight margin and a narrow posterior margin (see Figure 8). A couple of *Sclerocypris* instar varieties, juvenile carapaces, are present in the core: a smaller, thinner version of the adult and a subtriangular version.

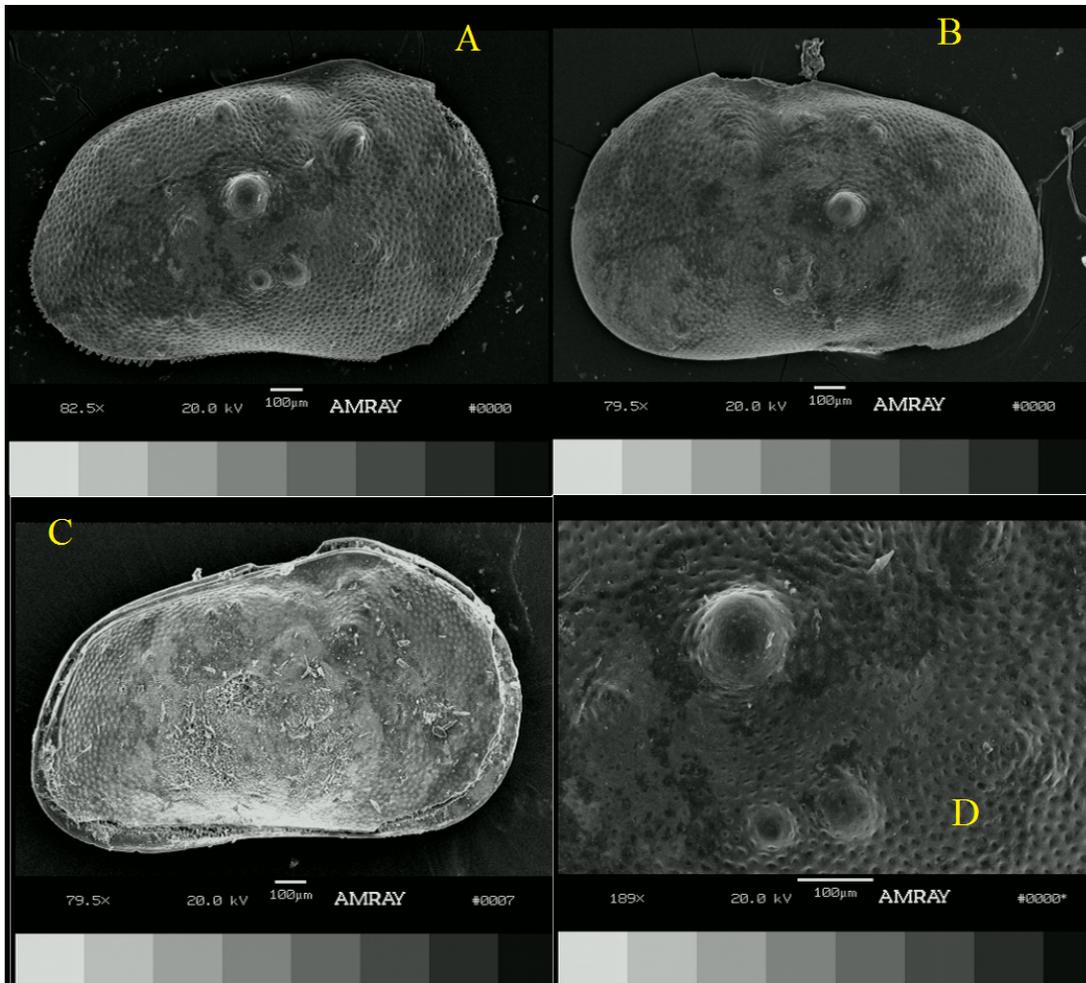


Figure 8. *Sclerocypris* spp.; A: Exterior view, right valve, B: Exterior view, left valve, C: Interior view, right valve, D: Noding on the exterior of *Sclerocypris* spp.

### ***Potamocypris***

*Potamocypris* is one of the least common ostracods in the core and when this genus is seen, the number of individuals is usually very low and very recrystallized. According to Brady and Norman (1889), *Potamocypris* are elongated-reniform shaped, compressed, and has a moderately arched dorsum. This species also can have shelves that protrude out of the anterior and posterior (See figure 9). The species with the shelves present is named *Potamocypris producta* and the species without the shelves is named *Potamocypris wothingtoni*.

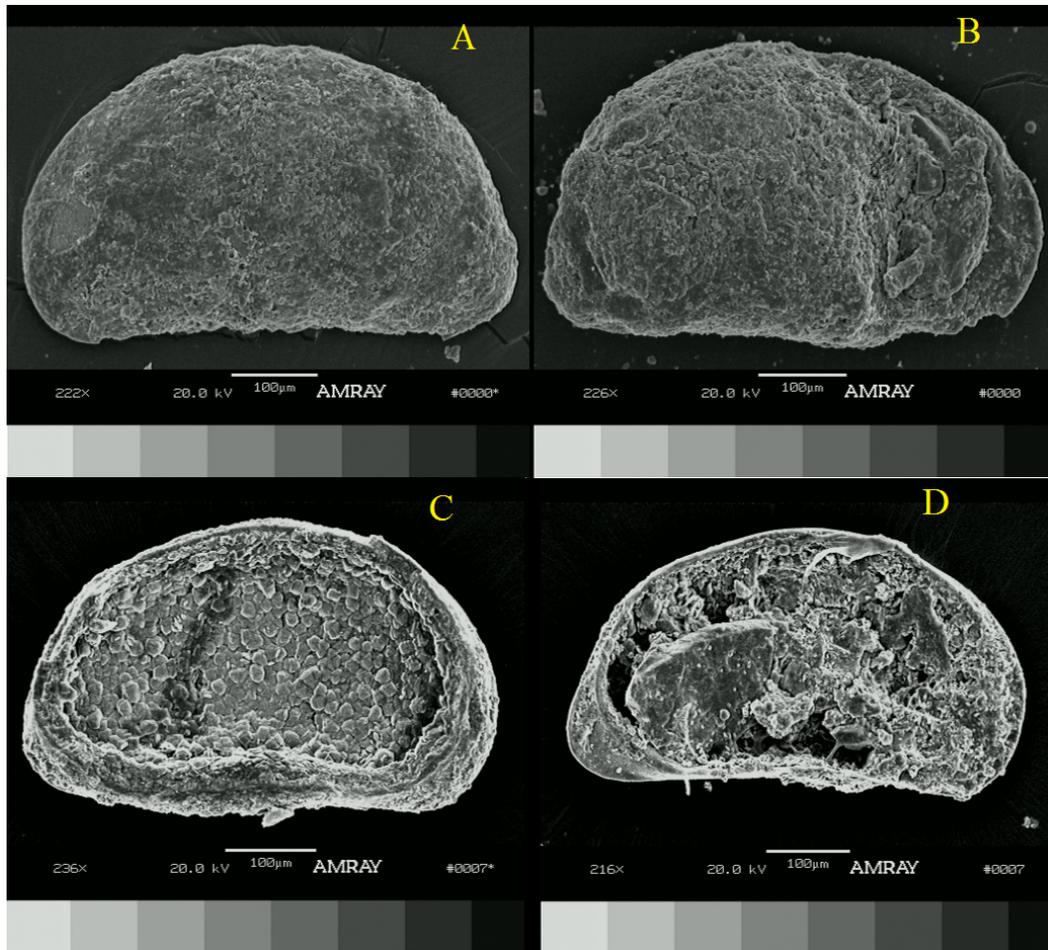


Figure 9. *Potamicypris*; A: Exterior view, left valve, B: Exterior view, right valve, C: Interior view, left valve, D: Interior view, right valve

### ***Darwinula* spp.**

*Darwinula* was present in very few samples and in sample individual numbers. Brady and Norman (1889) postulated that *Darwinula* is elongate-oblong in shape and has a muscle scar that has several elongated spots in a circle. No SEM pictures were taken because all of the valves found were broken and fragile.

*Plesiocypridopsis* spp.

*Plesiocypridopsis* is found in only two samples of the several that were picked.

According to Rome (1965), this ostracod genus is kidney-shaped, sub-triangular, and has an arched dorsum (Figure 10).

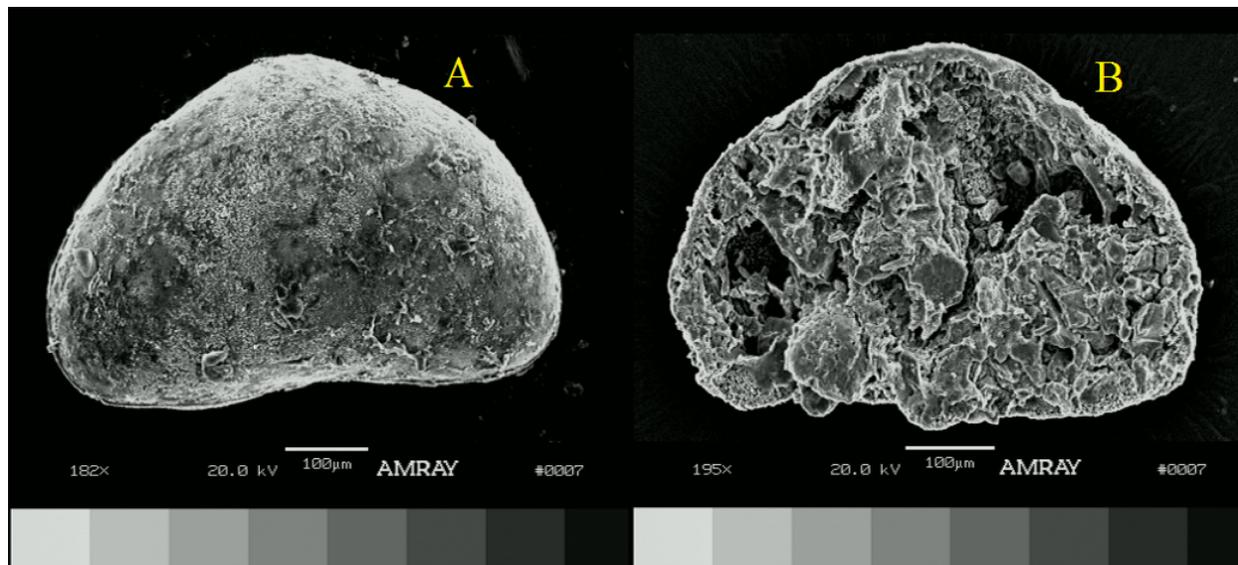


Figure 10. *Plesiocypridopsis* spp.; A: Exterior view, B: Interior view

**Ecological Patterns of Assemblages in Core**

This research attempts to find specific assemblages throughout the core that can show insight into paleoecology and future biostratigraphy. To understand ecological patterns throughout the core, samples with a fairly abundant amount of ostracods, several dozen, that are spaced enough through this core so that a complete view of the paleoecology is developed.

The total count of genera in each sample ranges from 2 to 6 genera with the sample being dominated by 2 or 3 genera. The environment and biological factors seems to only be able to hold up to 3 main populations of ostracods especially when those 2 or 3 populations are in large quantity and density. These populations could reduce limiting factors, such as living space, food, minerals and etc, and therefore outcompete the smaller numbered populations. The samples with

a smaller total number of ostracods did have larger individual population sizes and less domination of the sample by any particular genus. Evidence shows that one particular ostracod did not have a particular advantage in that environment or that the populations were not in that environment long enough for a couple of populations to randomly or due to some advantage become dominate.

Modern Lake Turkana has an assemblage that is dominate in *Hemicypris* with *Cyprideis*, *Ilyocypris*, and *Sclerocypris* being found as minorities to the community. This community assemblage will be the standard for comparison to the core.

The very bottom of the core at drive 81Q has an assemblage that is dominant in *Hemicypris* (see figure 11). This assemblage could show that the conditions in the lake are similar to the modern lake and the variables of the condition of the lake would be salinity and depth. The next two samples are from drive 74 Q and 73Q and these assemblages are dominant in *Ilyocypris*. *Ilyocypris* has a lot of nodding and pitting that allows for the ostracod to stand a higher salinity through deposition of the extra salts as parts of their carapace (do Carmo et al., 1999). Ostracods that cannot form pits or nodes are unable to deal with increases in salinity as well. Above drive 73Q to my highest sample, 15Q, the dominant ostracod is *Cyprideis*. *Cyprideis* in this core is reticulated and can be fairly convex. *Cyprideis* can handle increases in salinity by depositing extra carapace near the reticulation holes.

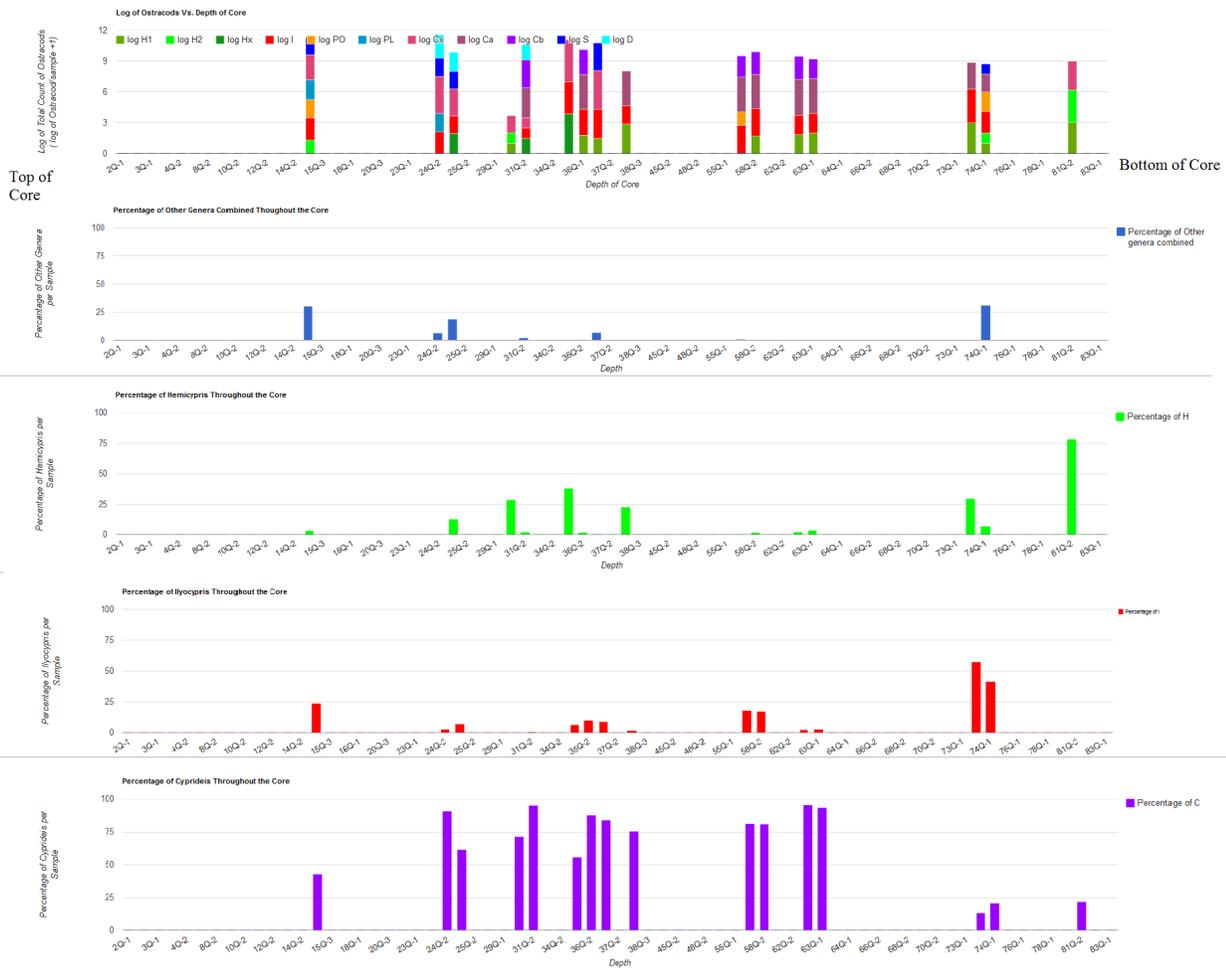


Figure 11. Distribution of genera of ostracod throughout the core

The change in assemblages throughout time and the core shows evidence that the lake’s water level and, in turn, salinity has changed. The bottom of the core was expected to hit a deeper lake phase which is supported by the *Hemicypris*-dominated assemblage because this assemblage is analogous to the modern, deeper lake. The next assemblage that is up section in core is the *Ilyocypris*-dominated assemblages.

One interpretation of this assemblage shows a time of high salinity and very low lake level. The abundance of a genus of ostracod that is able to tolerate very high salinities with an absence of ostracod genera that are accustomed to lower salinities would suggest that there was a

consistent low in the lake level. The last change in assemblage would be to the *Cyprideis*-dominated assemblage. This assemblage would indicate a slightly deeper phase than the *Ilyocypris*-dominated phase. There is pyrite present in many of the samples that are in this phase. This is evidence that there is a large amount of organics in the water and there is not much circulation in the water column. The type of environment that is would indicate would be a swampy, shallow lake.

### **Ecomorphs**

Variations in shell morphology occur due to environmental conditions, the main variable being salinity, which are called ecomorphs. While the main variables of the environment would be pH, temperature, and salinity, only salinity has morphological effects on ostracod carapaces (Yin et al., 2001). Only two genera had each two morphologies that could be candidates for ecomorphs, *Cyprideis* sp. A, C. sp. B and *Hemicypris* sp. 1 and H. sp. 2. *Cyprideis* sp. A and *Hemicypris* sp. 1 is present in the current modern lake assemblage while C sp. B and H sp.2 has not been seen before. *Cyprideis* sp.1 and C. sp. 2 are not completely binary morphologies; the two species types are actually on two extreme ends of a continuum of possible morphologies. This naming scheme was created for the convenience of picking and counting the genus. The possibility that this is an ecomorph is low because the variation in the genus is not related to spikes, pits, reticulation, or other forms of ornamentation. Variation manifests as changes in the whole outline and depth of the carapace. It is not easy to say whether this variation is due to salinity or just genetic variation. The variation of the genus *Hemicypris*, unlike *Cyprideis*, has binary morphologies. *Hemicypris* sp. 1 and H. sp. 2 are two separate species that do not have intermediate morphologies between the two species. This is not an ecomorph because the two

types of *Hemicypris* are not apparently interbreeding together. This core does not seem to have any significant ecomorphs throughout the core.

### **Conclusion**

In conclusion, the findings from the Hominin Sites and Paleolakes Drilling Project's West Turkana Kaitio 2013 core have been significant. Several layers from this core have been identified as coquina layers that were sampled, processed, and picked for ostracods. These ostracods can help tell a story about the ancient environment and paleoecology. This finding is significant because the Nattoo member of the core is correlated to be the same layer that the famous *Homo erectus* skeleton, Turkana Boy, was found.

The core has three phases: phase 1, phase 2, and phase 3 (See figure 12).

The first phase has deeper lacustrine deposits, from the Lorenyang Lake, that are below an altered bentonite layer that is thought to be the KBS tuff, the boundary between the Kalochoro member and the Kaitio member. The dominant ostracod is *Hemicypris* which is a similar assemblage to the modern, deep Lake Turkana. This supports the evidence that this phase was a deeper lake phase. Phase two is still below the supposed KBS tuff but has a significant different assemblage than previously; the phase is *Ilyocypris*-dominated. This shows evidence that the lake had a period of extreme regression and was a very shallow lake. The last phase, phase 3, is from right below the KBS to the top of the core.

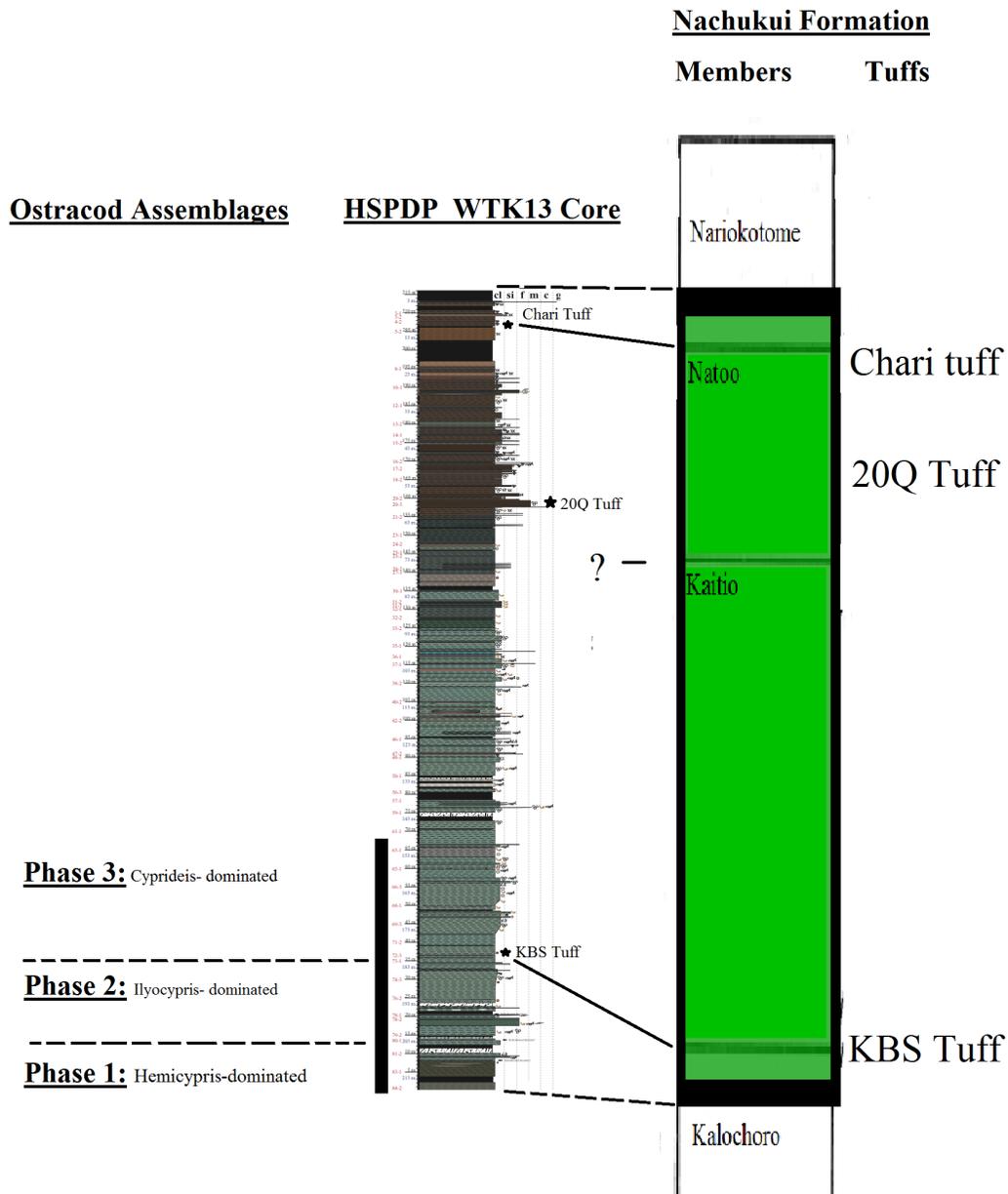


Figure 12. Correlation of Nachukui formation to the HSPDP-WTK13 core with ostracod assemblages

The third phase is dominant with *Cyprideis* and this shows evidence that the lake was shallow. Pyrite found in the core also shows that there was a large amount of organics and that the water column wasn't significantly circulated. This environment was a swampland that was very productive and this is supported by previous studies. The transition from a deep lake to a very shallow lake had a severe impact on the genera of ostracod in the lake. This transition

limited the amount of water and, because the lake is closed, increased salinity. Genera that are more able to handle higher salinity, by secreting ornamentation on its carapace, survived and, perhaps in some cases, thrived.

This study can lead the way for creating the infrastructure for the biostratigraphy of ostracods from Turkana Basin. As of now, biostratigraphy of ostracods is not used in this area because the history of these invertebrates is not clearly known. A sufficient survey of correlated coquina beds to the shell beds of the core can help support or reject the hypotheses in this thesis. This study has laid down well-constructed structure for future work on this core. Hopefully, prospective work will have even more successful results.

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## Summary of Thesis Samples

			depth	bottle
WTK13	1A	15Q-3	32-34	3
WTK13	1A	24Q-2	12-13	5
WTK13	1A	24Q-2	32-34	2
WTK13	1A	30Q-1	45-47	1
WTK13	1A	31Q-2	32-34	6
WTK13	1A	31Q-3	51-53	53
WTK13	1A	36Q-1	91-93	9
WTK13	1A	36Q-2	127-129	7
WTK13	1A	38Q-2	15-17	8
WTK13	1A	58Q-2	18.5-20.5	68
WTK13	1A	58Q-2	28-30	10
WTK13	1A	62Q-3	86-88	13
WTK13	1A	63Q-1	36-38	12
WTK13	1A	73Q-2	67.5-69.5	102
WTK13	1A	74Q-1	55.5-57.5	85
WTK13	1A	81Q-2	98.5-100.5	34