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SETTLEMENT PATTERNS OF THE HOMINIDS DURING THE PLEISTOCENE PERIOD: A CASE STUDY OF LOWER OKOTE MEMBER SITES; EAST OF LAKE TURKANA; MARSABIT COUNTY.

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other university.

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APPROVAL

This proposal has been submitted for examination with our approval as university supervisors

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DEDICATION

This work is dedicated to my dear parents

Mr. Francis Waweru Wakuna

And

Mrs. Nancy Wanjiku Mwaura

You have always believed in me and supported my ideas even though they made little sense to you!

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LIST OF ABBREVIATIONS

Mya- Millions of Years ago

WS- Weathering Stages

TT- Toth Types

ABSTRACT

The common denominator for early Pleistocene sites is hominid tool manufacture. The majority of excavated sites contain dozens of hundreds of stone artifacts. Although not all stone artifacts found at sites were manufactured at the location, the examination of these artifacts as a technological tool is important. Such examinations and analyses have been conducted widely and yielded vital information about early hominids' settlement patterns and life-ways. This study demonstrates the selective pressures that acted on our early hominids hence mediating their behaviors. While using stone tools as proxies, this study focused on an analysis of archaeological assemblages from four sites located in Karari, East of Lake Turkana; Marsabit County. The main objective of the study was to reconstruct patterns of behaviors of early hominids through the lens of material remains they left behind. Therefore, the study-specific objectives included as assessment of hominids' adaptive strategies that conditioned their behaviors in the procurement and use of diverse raw materials, an assessment of commonalities and variations of hominids' behaviors across sites as reflected by the archaeological assemblages, and a comparison of these patterns of behaviors across space. This study was guided by two theories; central place theory and resource availability theory. Stone tools from four sites (FxJj18 IHS, FxJj20 E, FxJj23, and FxJj50) were analyzed. Overall, twenty-six attributes were observed and recorded including, raw material types, amount of cortex, weathering, flake types, artifact types, and toth types. Stone tools data was analyzed through R- programing and PAST statistical tools. The results from the study indicate that to a greater extent, the availability of critical raw materials including food, water, and raw materials played a critical role in affecting hominids' behavior in the procurement, use, and discard of these resources. In this regard, sites such as FxJj50, located at the furthest distance from the raw material sources exhibited unique patterns of behavior in procuring and transporting different cobbles in anticipation of future use. FxJj23 represented a point on the landscape where huge stone tools could be made for transport later while FxJj20 East and FxJj18 IHS showed a point whereby modified stone tools were made for different tasks including pounding.

CHAPTER ONE

INTRODUCTION

1.1 Background information

Settlement patterns studies have in the past decades received significant attention Reeves (2019), Conard (2012), Toth et al. (2018) (Blumenshine 1984), (Harris 1978). Scholars from across the globe are interested in the material culture that the early hominids left behind and the meaning the materials represent. This renewed interest stems from the emergence of new lines of arguments regarding early hominids' life-ways and behavior in the choice and the location of sites on the paleo-landscape. Harris (1978), for example, in the original study of the Karari Industry and settlement patterns, argued that proximity to water sources played a critical role in the location of settlement camps by early hominids. According to him, water not only provided a critical resource for survival but also allowed easy access to other critical resources. Such resources included raw materials found in the river bed (stone cobbles) used in lithic manufacture. Presumably, water allowed the re-growth of fruiting trees along river banks that hominids procured at short distances for food gathering, e.g., at FxJj20E. Hence, while water was a critical resource for survival, other resources such as food and raw materials were essential.

In addition, the interest stems from recent evidence from previously excavated sites, such as the presence of palm trees at FxJj20E (Caroline Phillips, personal communication). Such new information has created the need to re-examine the material culture left behind by early hominids to reconstruct their behavior and life-ways patterns. Moreover, with the new lines of evidence from Reeves (2019), it is conceivable that the placement of these resources in diverse settings and the procurement strategies employed impacted the overall nature of assemblages in the archaeological record.

Conard (2012) has introduced a different line of argument after a detailed study of early hominid settlement patterns. On a broader landscape scale, his study of open-air sites in South Africa revealed that, during the Early Stone Age period, hominids preferred hilltop areas further away from the coastal waters (Conard, 2012). Another study, of the subsistence patterns of large carnivores, from Olduvai Gorge, has provided new information about the life-ways of the early hominids (Blumenschine 1984). According to the 1984 study conducted on meat-eating patterns of large carnivores from Olduvai George, other than the early hominids, the large carnivores played a vital role in accumulating bones at a site. While these occurrences could have been located anywhere on the landscape, the threat of predation by such large carnivores posed a considerable challenge (Blumenschine, 1984). In his study, these accumulations of carnivore-chewed bones may have provided scavenging opportunities for early hominids. Somehow, the accumulations were associated with stone artifacts (sites) and are thus proxies for reconstructing hominids' diets and occupations (settlements) at specific points on the ancient landscape. These debates, therefore, raise questions about early hominids' settlement patterns and lifeways and the role played by the availability of critical resources for survival in the placement and location of these settlements as well as the overall behavior and lifeways of early hominids.

This research attempts to expand the breadth of knowledge about hominid behavior and settlement patterns during the early Pleistocene period through a detailed study and examination of their technological advancements. In most instances, African lithic assemblages have been used to reconstruct regional and spatial chronologies based on the diverse morphological differences of these artifacts. Hence, when behavioral inferences are made from such analysis, this only allows for conservative and morphological assumptions about the technology. This study goes beyond the conservative approach of making behavioral inferences from morphological analysis by providing a detailed analysis of the artifacts from the key sites. This is because previous research by Presnyaklova (2019) and Dibble (2005) has revealed that both differences in the typology and morphology of the artifacts might be related to a myriad of factors. These include; the differences in raw material types, artifact function, core reduction as well as cultural traditions involved hence settlement patterns(Presnyaklova 2019, & Dibble 2005). These factors significantly contribute to the variations in artifact assemblage.

Therefore, a better way to understand these variations can be generated through a detailed study of the technology involved in the production of these tools. Moreover, by comparing procurement strategies of these diverse lithic raw materials, as well as assessing in what form they were acquired from exotic or local sources, assessing the degree of reduction and the technique involved in the reduction of these local (basalts) and exotic raw materials (such as chert and ignimbrite), it was possible to document differences in early hominids settlement patterns across space (i.e., ancient landscape). Upon documentation of these differences, it is possible to address the question of spatial variability in assemblages.

This research gives a detailed analysis of the nature and variability of the Karari industry through an intra and inter-site scale. By choosing to research the Karari sub-region, it is possible to expand the already existing database for the region. Also, it allows for a comparison of the new database with the existing ones in-order to shed light on the patterning variability within the Karari assemblages as a whole and to pose questions about the meaning of such variability to infer about early hominids' settlement patterns.

To document and reconstruct variations within the Karari Industry, an analysis of stone artifacts from previously excavated early Pleistocene sites was reanalyzed and compared. In the traditional Archaeological classification nomenclature, the terms Oldowan and Developed Oldowan are core and flakes variants based on time and characteristics of the artifacts that overall constitute the Oldowan Industrial Complex (Gowlett, 1988). In previously reported descriptions by (Leakey 1971), the stone assemblages East of Lake Turkana in the time interval (1.5-1.6 Ma) were classified and given a local name; the Karari Industry, a variant of the Developed Oldowan Industrial Complex. Consequently, the patterning of the technological adaptations was compared across sites. This made it possible to assess whether or not the variations within the Karari Industry (i.e., one of the variants of the Developed Oldowan) were site-specific or not.

1.2 Goal

The main goal of this research is to reconstruct early hominids' behaviors and settlement patterns using stone tools as proxies. Hence, the study assessed the nature and diversity of developed Oldowan (Karari Industry) archaeological occurrences from four geographically distinctive regions.

1.3 Problem statement

The common denominator for early Pleistocene sites is hominid tool manufacture, and the majority of excavated sites contain dozens or hundreds of stone artifacts. Although not all stone artifacts found at sites were manufactured at the location, examining these artifacts as technological tools is essential since stone tools are the longest surviving record of hominids' activities millions of years ago. Such studies and analyses have been conducted widely and yielded vital information about early hominids' settlement patterns and life-ways. Understanding early hominids' settlement patterns has been the main focus of recent studies in different parts of the world, including Tanzania (Blumenschine 1984), South Africa (Conard 2012), and Kenya (Harris, 1978), Reeves 2019). As a result, of these studies, the debate on early hominids' land use and subsistence patterns has taken a unique direction in recent years. Some scholars have argued that early hominids preferred hilltop environments away from the coastal waters (Conard, 2012) while others maintained that water availability dictated not only the location of sites but also procurement locations (Harris, 1978).

An additional study of the Olduvai collections from Tanzania defines sites as "Caches ", which were occurrences of the stone artifacts resulting from repeatedly returning to known places on the ancient landscape to access raw material from the same place (Potts 1988). Though these studies have been conducted elsewhere in the world, there are fewer settlement studies in Kenya, (Harris, 1978; Nyanchoga, 2012; Reeves, 2019). In addition, despite yielding critical information about the lifeways of early hominids during the Pleistocene period, basic analytical techniques were employed by Harris (1978). For example, his study involved comparing spatial relationships across different sites on contrasting landscapes. In contrast, Reeves, (2019) study focused on understanding the mobility patterns of early hominids during the Upper Okote period using cortex ratios, proxies, and surface collections. Even though Harris (1978) was informative and patterning to the location of sites was reported, the hominid behavioral issues of this pattern were not fully investigated. Further, while Reeves (2019) study used surface collections to trace such patterning to hominid behavior during the upper Okote period, excavated materials have not been studied to trace any patterning during the Okote Member times. My study aims at filling this gap and delineating early hominids' patterns in procurement and use of diverse resources on the landscape including the overall impact of such activities on their behavior.

A detailed study of the significant variations (in tool modifications, composition, and character) that have been cited in previous literature within the Karari Industry (Lepre, 2017) will reveal the commonalities and variations within the Karari assemblages, which would inform about early hominids settlement patterns and lifeways. Therefore variations of the Karari Industry, and the availability of new methodological techniques (Toth., 1982, Dibble. et al. 2005; Presnyankova, 2018) as well as the new information on the sites, for example, the presence of palm trees from FxJj20E (Caroline Phillips, Personal communication) allows for a restudy of early hominids settlement patterns. Thus my study focuses on a more detailed analysis than earlier conclusions of early hominids settlement patterns (Harris, 1978).

1.4 Research questions

1. What were the adaptive strategies of the early hominids in preference to and use of lava (basalt) and exotic (chert, chalcedony) materials during the early Pleistocene period?
2. What were the commonalities and variations of the hominid settlement to resource availability?
3. How do settlement patterns and lifeways of early hominids compare across the key sites of study?

1.5 Objectives of the study

1. To reconstruct adaptive strategies of early hominids in preference to and use of lava (basalt) and exotic (chert, chalcedony) raw materials during the early Pleistocene period.

2. To explain the commonalities and variations of early hominids' settlement patterns to resource availability.
3. To compare early hominids' settlement patterns and life-ways across the key sites of study.

1.6 Hypotheses

1. Distance from vital resources, including food, water, and raw materials, influenced settlement location, size, and permanence.
2. Hominids were involved in unique inter-site and intra-site activities.
3. There is a direct correlation between site distance from a primary source of raw material (basalt) and the size of artifacts, amount of cortex, and frequency of basalt raw material in the assemblage.

1.7 Justification of the study

The sites within the Karari escarpment are vital in reconstructing hominid behavior during the early Pleistocene period. The key sites cover a broader geographical scale of 72km square hence allowing sampling over a wider scale. A crucial factor is the paleo landscape's penecontemporaneous (uniform) nature to sites. Also, the sites fall within a well-defined time horizon 1.5 million years ago, i.e., Lower Okote Member geological deposits. In addition, unlike many sites within the area, these sites are located in low-energy flood plain contexts hence providing temporal and spatial (across time and space) security. Further, this study is very significant because, even though earlier studies on settlement patterns have been done (Harris, 1978), the new developments in archaeology, including new analytical techniques that were not available at the time, necessitate a restudy of early hominids' settlement patterns(e.g amount of cortex studies).

In addition, new insights from the sites, including; reports on the presence of palm trees at FxJj20 East, create a need for this study (Caroline Phillips, personal communication). Overall, this information is vital in examining possible hominids' diets and the settlement decisions involved. By using artifacts as a "key," I will be able to search for patterns in size differences, flake type, flaking techniques, platform types, amount of cortex, and termination type, which will inform about site patterns and reflect hominids' behavior.

1.8 Scope of the Study

The study was conducted within Marsabit County, East of Lake Turkana, with data collected from the key sites located within the Karari escarpment (FxJj18 IHS, FxJj23, FxJj20 E, and FxJj50). Key sites were targeted for this study because they are located in different paleo-geographical settings and a flood plain depositional environment except for FxJj23. The site is studied for comparison purposes as it is located at the closest distance to the raw material sources of all Karari sites on a penecontemporaneous land surface. For instance, FxJj50 is the furthest from raw material source and has the highest number of cut-marked bones in the region, FxJj18 has the highest number of modified tools, FxJj20 E has the highest evidence of fire and pounding tools (Harris 1978).

1.9 Limitations and delimitations of the study

The study's major limitation was the accessibility of all the materials in the lab at the National Museums of Kenya. Since the excavation in 1972, researchers have widely analyzed the materials, and there are a few missing pieces. A detailed examination of the artifacts in their respective boxes helped minimize the challenge where the few missing pieces were noted down, ensuring that all samples used in the study were valid. In addition, the starting point of this analysis was the retrieval of site fieldnotes from the archives at the National Museums of Kenya with which the pieces were put back into their respective bags and trays.

1.10 Definition of operative terms

Hominids: English dictionary defines hominids as any member of the Hominidae family including modern humans, extant humans, and great apes. In this research, I define early hominids as members of extinct ancestors including Australopithecines, Homo habilis, and Homo erectus

Curation: English dictionary defines curation as the process or action of selecting, organizing, and looking for items from a collection. For this study, I define curation as the action of carefully selecting tools from one site and transporting them for use elsewhere.

Pleistocene: The word is often referred to as the Ice Age and it is a geological epoch formed during the first epoch of the Quaternary period which lasted for about 1,600 000 years denoting, or formed in the first epoch of the Quaternary period, which lasted for about 1 600 000 years. In contrast, the youngest epoch, the Holocene (The last 12000 years)

Life-ways: English dictionary defines life-ways either as a way through life, a course through life, or a way or manner of life. For this research, I define life-ways as differently combined means through which prehistoric people lived, including land use, subsistence strategy, resource mobilization, social organization, and technological adaptations.

Patination: According to the English dictionary, patination refers to a change in the skin color of a metal due to exposure to sunlight. In this research, patination implies a change in color and loss of sharper edges of a stone tool due to exposure to sunlight or as a result of rolling by wind or water over a long period.

Commonalities: According to the English dictionary definition, commonalities refer to sharing characteristics in common. In this study, the word commonalities was used to refer to shared features and characteristics in stone assemblages from the key "sites."

Cortex: English dictionary defines the cortex as the outer layer, especially the brain and other organs. In this research, the cortex is defined as the outer layer of a cobble before reduction.

Homo erectus: Most paleoanthropologists have used this term to refer literary to an upright man. Erectus remains have been found widespread in Asia, Africa, and Europe. In this study, reference will be made to Homo erectus.

Homo ergaster: This is used literally to mean working man as most paleoanthropologists have used it. My research would treat Homo ergaster as a variant of Homo erectus, presumably an earlier variant of the Homo erectus, and were found in most parts of Africa.

Primary Flakes: This term is literary used in the study to refer to flakes made in the initial stage of core reduction. Primary flakes tend to be either fully cortical or with one flake removal on the dorsal surface.

Secondary flakes: This term is literally used in the study to refer to flakes made after the

Tertiary flakes: This term is literally used in the study to refer to flakes made later in the primary flakes have been removed. These tend to have a small cortical surface on the dorsal surface with more than two flake scars.

Settlement patterns: English oxford dictionary defines settlement patterns as the way houses and buildings are distributed in rural settlements. In this study, settlement patterns are used to refer to behaviors in the placement of settlement camps, and procurement use and discard of resources on the landscape.

Variation: According to the English dictionary definition variation refers to a different or distinct form or version of something. In this research, variation implies differences in terms of shape, form, design, and amount of cortex among other attributes.

Adaptive strategies: In this research, the term is used to refer to the idea that organisms are fitted for the particular environments in which they live.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This chapter provides a review of the literature that is critical to this research as it has been presented by various scholars, researchers, and authors. The chapter is divided into thematic areas. The first section covers Archaeological studies that relate to the research. Archaeological studies cover previous studies based on archaeological evidence that informs about hominids' life-ways and settlement patterns. The second section covers ethnographic studies that relate to this research. It explores previous and current ethnographic studies pertinent to this research and whose findings can be extrapolated to make inferences about hominid behavior. The third section of this chapter covers two theoretical frameworks. It explores theories that attempt to offer possible explanations for the findings of the study regarding hominids' behavior in the procurement, use, and discard of artifacts on the paleo-landscape.

2.2 Archaeological evidence

Debates around early hominids' land use and subsistence patterns have taken unique directions in the last half a decade. Numerous studies have revealed that the settlement patterns of early hominids have been changing temporarily and across space. For example, according to Rogers (1994), settlement patterns during the Plio-Pleistocene period were sporadic due to the sparse and restricted nature of the resources. In contrast, during the Early Pleistocene period hominids exploited a wider range of settings especially along with watercourses (Rogers, 1994).

While numerous studies exist on Lake Turkana Basin, the only existing study of the early hominids' settlement patterns during the early Pleistocene period in Koobi Fora dates back to 40 years ago (Harris, 1978). According to the study on spatial relationships across sites within the Karari escarpment, critical resources such as water, food, and raw material availability played a critical role in early hominids' settlement patterns. Of these resources, the study revealed that water played a significant role in dictating patterns of hominids' settlement and procurement strategies. This is because, it not only provided a vital resource for survival but also allowed the presence of fruiting trees (Bamford, 2017) and transported cobbles suitable for tool manufacture.

While the water was crucial in supplying stone raw material on the Paleo-landscape, transport of flakable cobbles might not have been possible, especially for sites located at far distances from the raw material source such as FxJj50. A study of conglomerates at key sites in the Karari escarpment such as FxJj 50 revealed that the cobbles within the conglomerates were too small, (less than 9 mm) hence not suitable for tool manufacture (Lepre 2009). According to Lepre, hominids traveled for long distances to procure raw materials or "curated" carried manufactured tools from factory sites at river conglomerates. The dynamics involved in the availability of critical resources as well as procurement strategies applied would without a doubt dictate early hominids' settlement patterns. Since the detailed study on early hominids' settlement patterns 40 years ago(Harris 1978), no further detailed study of possible existing patterns during the early Pleistocene within the Lower Okote Member has been undertaken and this study attempts to bridge that gap.

Other studies on settlement patterns date back to 2012 on open sites in South Africa by Conard (2012). This new research has provided a new understanding of early hominids' settlement patterns and life-ways, which have also sparked a lot of controversies. On the one hand, whereas some researchers such as Harris (1978) argue that during the early Pleistocene period, early hominids were tethered to areas in close proximity to water sources, the study of open-air sites in South Africa revealed that during the early Stone Age period, hominid preferred hilltop environments, further away from the coastal waters (Conard, 2012).

Another study, of the subsistence patterns of large carnivores, by Blumenschine 1984 from Olduvai Gorge has provided new information about the life-ways of the early hominids. According to the survey conducted on meat-eating patterns of large carnivores from Olduvai Gorge, other than the early hominids, the large carnivores played a vital role in the accumulation of bones at a site. While sites could have been located anywhere on the landscape, the threat of predation by such large carnivores posed a considerable challenge (Blumenschine, 1984).

2.3 Ethnographic evidence

Due to the paucity of settlement patterns studies of early hominids during the Pleistocene period, ethnographic studies on hunter-gatherer communities provided proxies for understanding the life-ways and behaviors of early hominids (Binford, 1984). These studies are vital in studying the settlement patterns of the early hominids as they provide models through which inferences about early hominids' settlement patterns could be made. For example, a study of the Nunamiut Eskimos of North Alaska and the San revealed that the environmental setting significantly impacted their behavior (Binford, 1980). According to him, the San had seasonal movements, especially with the food resources including; melon patches and standing water points. Thus, small mobile groups were formed at far distances and gathered food over wider geographical settings upon depletion of the vital resources. Such activities created different archaeological signatures. For instance, in the first group of the San community, huge archaeological assemblages were left behind; in contrast, the small foraging units left behind minimal archaeological signatures. Such inferences can be applied to understanding the paucity and abundance of archaeological occurrences in some sites compared to others and reconstructing the overall behaviors of the early hominids.

In contrast, the Nunamiut gathering strategy was large groups based on an encounter basis, and the gathered food was for daily consumption. Upon eating to their fill, they returned home to their home bases. This group left behind huge archaeological signatures compared to the San small groups (Binford 1980). Binford's work on the hunter-gatherer societies revealed that different occupations left behind different archaeological signatures; ephemeral occupations, for example, were characterized by fewer more site-specific tasks compared to those in longer-term occupations (Binford, 1979).

In a study by Harrison (1949) on the Punam people, it was revealed that the group was highly mobile in search of vital resources from one place to another on the landscape. As a result of such greater mobility, little time was taken to use and discard tools. Consequently, fewer archaeological assemblages were left behind.

In another study by Henry D on different tool classes from different environments in South Africa, it was revealed that settlement permanence significantly impacted the nature of tools in an archaeological site (Henry D, 1979). According to the author, low-land sites were dominated by microliths, unlike the highland sites. This was, associated with longer occupation periods that provided enough time to prepare and design tools with greater detail and fabrication. In contrast, the highland sites were dominated by retouched tools resulting from the seasonal occupation of the sites.

Whereas settlement studies have been conducted across the globe, the paucity of settlement studies dating to 1.5 million years ago in Koobi Fora remains an issue of major inquiry (Harris, 1978, Reeves 2019). As noted earlier, while several studies exist on early hominids' settlement patterns, including archaeological evidence and ethnographic studies of the hunter-gatherer societies; fewer studies exist on early hominid settlement patterns during the Early Pleistocene period. An analysis of the variations within the Karari assemblage is vital in understandings the dynamics around early hominids' settlement patterns and in the reconstruction of their behavior at 1.6-1.2 million years ago.

2.4 Theoretical framework

During the Pleistocene period, early hominids formed an important part of the biosphere, especially through their activities of stone procurement, manufacture, and acquisition of food resources. Hence, their settlement behavior became an important aspect of their livelihood that depended on several factors. Several theories have been advanced to explain these settlement patterns. The following theories have formed relevance in this research and have been applied to this research.

2.4.1 Central place foraging theory

Proposed by Schoener, & Orians& Pearson (1979), the theory revolves around the dynamics of choice of load size by the central foragers. The model is based on the following tenets; First, when load mass has no effect on the time taken to the central place, then the optimal load mass to be transported by the central place forager increases with increasing distance. Second; when a central forager transport a load relative to their body mass, then travel time to the site is increasing.

This theory is vital in this study as it helps one understand the dynamics involved in the procurement of critical resources for the survival of early hominids. It explains the impact of such activities to site location and use as well as the nature of manufactured tools on a site. According to the theory, the central forager had to determine in advance the place to locate the site, in relation to the distance to procure the load and the size of the load to be transported. The model maintains that transporting loads bigger than their body mass, increased the amount of time taken to transport them. Further, when the distance from the resources increased, the size of the load decreased significantly.

Tool manufacturing is a very reductive process. Where and how these tools are discarded is determined by many factors. It is critical, therefore, to understand the dynamics involved in tool manufacture. Sites under study are located away from the raw material source hence; "curation" was a very important practice. This theory offers possible explanations for site location and settlement patterns. For instance, the dynamics involved in the transportation of a cobble from a distance of 20km from the basin margin to the site. As a result, sites with less archaeological materials compared to others might have resulted from the dynamics involved in transporting cobbles over long distances with sites close to raw material sources representing a myriad of activities.

Additionally, central place foraging theory would offer possible explanations about the variations in the abundance of usable tools across sites. For instance, a lack of usable tools such as flakes at a site would imply that they foraged over long distances. This is where initial food processing took place to reduce the load size after which it was transported to the central place. In contrast, if these resources were located in close proximity to the central place, the majority of the activities took place at the site and this can be identified by the presence of diverse stone tools including flakes, cores, debris, and cobbles.

While this theory is very informative it does not offer possible explanations for the trends involved in the procurement and use of exotic raw materials present at the sites. It is in this regard that a second theory is used in the study; resource exchange theory. This theory informs about different types of interactions between humans. Therefore, it will offer possible explanations of dynamic activities involved in the procurement and use of exotic raw materials as represented at the sites.

2.4.2 Resource exchange theory

The theory was advanced by Foa and Foa (1971) and was applied to explain different types of social reciprocal interactions between humans Foa and Foa (1971). The theory revolves around the following tenets; exchange practices by people involve several things including money, love, status, information, as well as goods and services. Foa and Foa categorized these resources into two; hence particularism and concreteness. Particularism is used to refer to the extent to which the value of a certain resource is significantly determined by the people involved in an exchange. Concreteness refers to a type or form of expression that is characteristic of the different kinds of resources; this includes its quality, shape, and appearance. For instance, an object considered to be of good quality and shape is likely to command a better price compared to the less attractive one. Therefore, settlement patterns of early hominids during the Pleistocene period are viewed through the lens of the resource exchange theory to shed light on the underlying factors that might have facilitated the procurement, manufacture, use, and discard of exotic raw materials as exhibited in the archaeological assemblage. Similarly, resource exchange theory provides that in exchange, the costs must be weighed against rewards. Hence, the people involved in exchange only did so if there was any gain for them, a pattern that might have persisted in the procurement of exotic raw materials.

The patterns behind the procurement, manufacture and use of these resources remain unclear. This theory offers possible explanations regarding such patterns including whether exotic raw materials such as chert, ignimbrite, chalcedony, and quartz were procured for several rewards including their ability to produce sharper edges, durability, and flakability compared to lava raw materials or not. If that was the case then, it is conceivable that such materials were, only procured if the rewards outweighed the cost.

2.5 Conclusion

In conclusion, archaeological and ethnographic evidence has put the previous studies on hominids' settlement patterns into context. For instance, archaeological studies have revealed in detail existing studies pertinent to this issue. In addition, it has presented debates surrounding such issues pointing out the gap to be filled by this study. Ethnographic evidence has informed how real-life experiences of modern analogies can be extrapolated to understand the dynamics of hominid behavior. In the last part of the chapter, the theoretical frameworks have offered possible explanations for the proposed hypothesis of early hominids' behaviors that remain to be tested against scientifically collected and verifiable datasets.

CHAPTER THREE

THE STUDY AREA AND SITES

3.1 Introduction

The Chapter is divided into two main parts; study area, and sites. The study area is divided into three thematic areas; climatic conditions, vegetation, and the geological setting. Climatic conditions explore past climatic conditions in the Turkana Basin that prevailed during the Pleistocene times as reported in previous studies. It also encompasses modern climatic conditions as an analog of the past. Similarly, the vegetation section examines the past, tracing its change over time to the present and reporting its overall impact on Hominid behavior and lifeways. The geological section puts the study area and sites into context by informing about changes in the geology of the paleo- landscape and its impact on patterns of hominids' behavior. The second section of the chapter explores the history of the dating of the Turkana basin while reporting on the relative dates of the study sites. A description of the Karari industry forms the second part of the second section of the site. This offers a detailed description of this developed Oldowan technology including its origin and regional implications of the term. The last and final section of the chapter examines in detail the key sites' understudy including their location on the modern landscape and archeological materials recovered.

3.2 Study Area

3.2.1 Climatic Conditions

The Turkana Basin in the North West of Kenya is part of the Eastern branch of the East African Rift system (Ebinger et al., 2000). Today, the Turkana basin contains one of the largest rift lakes, Lake Turkana, with an area of 7,500 km square (Frostick, 1997). The lake receives most of its waters (90%) from the rainfall received over the Ethiopian highlands via the Omo River and minor inputs from the Kerio River and the Turkwell River. Overall, the area receives an average rainfall of 259-500 mm hence the general climate ranges from arid to semiarid (Frostick 1997).

Climatic changes experienced across the globe are responsible for the arid and semiarid nature of the Turkana landscape today. During the Pleistocene period, the climatic conditions were more favorable and provided a suitable habitat for fauna and flora communities. The availability of such resources allowed the coexistence of three hominid species; Australopithecus boisei, Homo habilis, and Homo erectus (Wood, 1991). The dramatic climatic fluctuations witnessed during the time allowed the growth of diverse food resources and the evolution of various fauna species that early hominids depended on for survival. The presence of many cut-marked bones at FxJj50 is a clear indicator that hominids incorporated meat into their diet (Bunn, 1982). Additionally, pounded tools at FxJj20 E, one of the sites with the earliest evidence of palm trees, reinforce the argument that the landscape was endowed with critical resources for survival that early hominids procured across the landscape (Bamford, 2017). The presence of fossil hippos and croc remains in sites such as FxJj50 reinforces the assertion that the Karari paleo-landscape was wetter (Bunn, 1982).

The changing climatic conditions within the Lake Turkana basin at the time significantly impacted the overall placement of resources on the landscape that early hominids procured. According to (Rogers et. al, 1994), archaeological occurrences were located along with the toes of the alluvial fans at 2.3 m.y.a. In these alluvial fans where a marginal drainage system that contained the raw material used in lithic manufacture fed into the axial Proto- Omo which at this time was a large meandering river that had a perennial supply of water (Rogers et. al, 1994),.

Therefore, because of its sparse and sporadic nature, tool use during this time was considered seasonal or sporadic.

A different pattern was recorded at 1.9-1.8 m.y.a whereby archaeological sites were located along marginal streams and watercourses, the presumed sources of raw materials (Rogers et. al, 1994). However, at 1.6 m.y.a, a different trend was observed whereby archaeological occurrences were not necessarily tied to the sources of raw materials; different landscape settings were explored at the time. Stone artifacts recovered dating to this period were found both in proximal and distal depositional environments which would have been located at far distances from the stream beds whose cobbles, and could be used in the manufacture of stone tools (Stern, 1991). Hence at the time, early hominids occupied areas with diverse climatic conditions.

(See fig. 3.1 a-e)

3.2.2 Vegetation

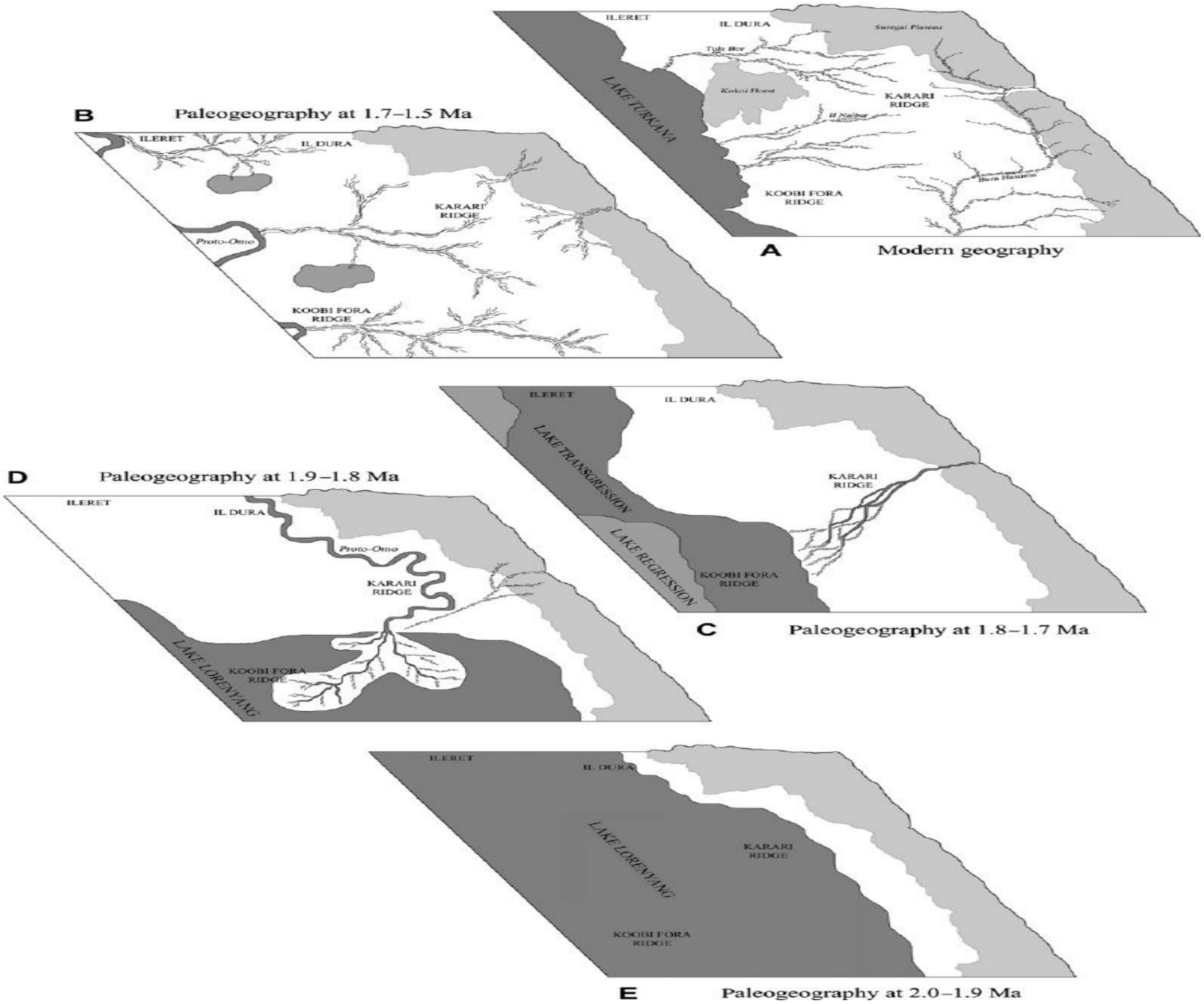
Vegetation surrounding the Turkana landscape has changed significantly over time. Widespread grasslands and river-line forests that dominated the area during the Pleistocene period have been replaced by semi-arid vegetation cover including shrubs, cactus, and commifera plants. Nevertheless, the area is home to a variety of wild animals found within the Sibiloi national park. Their movement across the landscape is highly determined by the availability of pasture and water. During the drier seasons, the animals' frequent areas close to the lake where the availability of water and pasture is ensured. Additionally, pastoralist communities living around the area depend on similar resources for their domestic animals including goats, cows, and sheep. Equally, their movement is primarily conditioned by the availability of critical resources such as food and water. A study by Ndiema (2011) revealed that these groups of people are highly mobile during the dry seasons when resources are scarce and less mobile during the wet seasons. Understanding the dynamics of such patterns of movements is vital since they can be used as proxies for reconstructing hominids' settlement patterns.

However, during the Pleistocene period, the Lake Turkana paleo-landscape was not uniform. For example, Quinn (2007) noted that the three sub-regions (Karari Ridge, Koobi fora Ridge, and Ileret Ridge) within the Koobi Fora Formation, experienced different climatic and environmental conditions. According to her, the marginal rivers and the axial systems within the Karari ridge were responsible for sustaining the wooded environments while other sub-regions were beginning to have a wider spread of the grassland environments. Hence, Karari was wetter while other sub-regions were drier. The presence of fossil hippos and croc remains in sites such as FxJj50 reinforces the idea that the Karari paleo-landscape was wetter (Bunn, 1982). This argument is contrary to the earlier arguments by Behresnmeyer (1982), that the Karari Subregion was dry. The reconstruction of the oxygen c^13 values revealed that the area was wooded and wetter than in other regions from 2.0-1.5 Ma (Quinn, 2007). It is therefore conceivable that the variations within the Karari Industry might have resulted from the occupation of such diversity in paleo- microhabitats.

3.2.3 Geological setting

The Turkana Basin area is renowned for its huge lake; Lake Turkana which is home to many faunal and plant communities. Over the past few decades, detailed geological investigations around the Turkana basin have been done by researchers across the globe (Fiebel, 1981, Gathogo, 2006, Lepre 2007). Such studies have revealed that, on the western side of the lake, the Miocene –Pliocene volcanic rocks (the basalts) at the Surgei Cuesta (Source of basalt raw material used in lithic manufacture (Braun, 2009)), define this border while the eastern region is defined by deposits the Koobi Fora Formation (Watkins, 1986). This formation is exposed in several sub-regions within the basin including the Koobi Fora Ridge, Ileret, II Dura Ridge, and the Karari Ridge, which have been divided into numbered archaeological and paleontological collecting areas (Fiebel, 1981). Within the Koobi Fora Formation, 8 tuffs have been well identified and studied in detail; Lonyuman to Chari members, the Okote member that dates to 1.6 million years ago lies within the Koobi Fora Formation (see fig. 3.2).

The area is endowed with sediments with artifacts and faunas bearing outcrops along the Karari escarpment and at Ileret. Plio-Pleistocene deposits exposed in these regions preserve a very rich record of Paleo-environmental change as well as hominid evolution for a period of 4.0-1.0 Ma (Brown and Fiebel, 1991). Fiebel et al 1991 noted that the Turkana landscape has been undergoing significant changes over the years. For example, unlike the present Lake Turkana basin which is characterized by an inland lake without an outlet, reports (Brown & Fiebel, 1991) have demonstrated that during the Plio-Pleistocene period, the basin was dominated by a fluvial or a lacustrine depositional system whereby at 2.4 Ma, a deep lake was formed that occupied most of the basin's axis. At 1.87 Ma, the lake underwent a series of oscillations in the water level and became shallow culminating at 1.78 Ma, with the development of a limited biotic community and restricted circulations (Lepre 2007). This was soon followed by a very large river dominating the diverse landscape 1.6 Million years ago, (Rogers et al. 1994). Additionally, at 1.6 mya, Gathogo & Brown, (2006) noted that fluvial conditions resumed dominance in the basin; this is the same period that the study is based on. The figures below provide these changes in paleo-geography across time. See Fig. (3.1 a-e)



Key:

Fig 3.1a: a figure showing the modern geography of the Turkana basin characterized by many meandering streams from the basin margin.

Fig 3.1b: A figure showing the changing paleo-geography of the basin from 1.7-1.5 m.y.a

Fig 3.1c: A figure showing changes in the basin paleo-geography at 1.9-1.8 characterized by the appearance of one river that drained beyond Karari Ridge

Fig 3.1d: A figure showing the appearance of the proto-omo river that formed the outlet of the then lake

Fig. 3.1e: A figure showing the paleo-geography of the basin at 2.0-1.9 m.y.a when the lake lacked an outlet.

(After Isaac and Behrensmeyer, 1997).

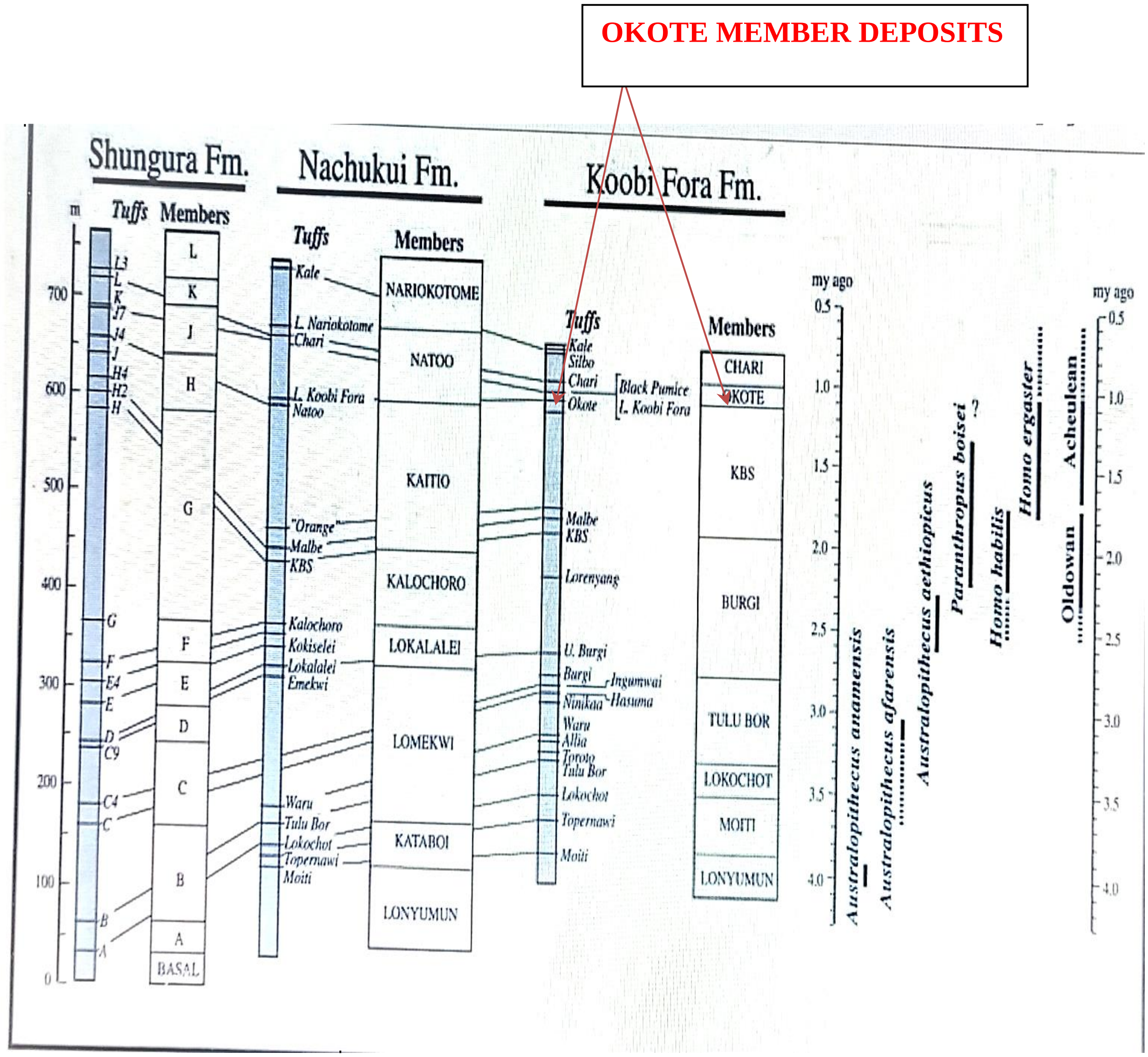


Fig. 3.2: A figure showing a section of artifacts bearing formations with individual members. The arrows point to the deposits of interest for this study; The Okote member deposits Fiebel, et. Al. 1989)

3.3 Sites

3.3.1 Dating

The sedimentology and stratigraphy of the Koobi Fora Formation have been studied in detail over the past decades, (Rogers et al: 1994, Fiebel 2013, Bennet et al., 2009 Brown and Fiebel, 1991), whereby Strontium (Sr) and Magneto-stratigraphy isotope stratigraphy dating techniques have been employed widely, especially in dating hominid bearing deposits in Koobi Fora. As a result, eight members were distinguished and studied in detail within the Koobi Fora formation, (Fiebel 1991). The sites under study are located within the Okote member, one of the eight members within the Koobi fora formation.

Even though the outcrops within the Koobi Fora formation are discontinuous, radio-metrically dated and correlated tuffs, well-established geomagnetic polarity stratigraphy as well as aerially extensive bioclastic lacustrine beds have allowed for stratigraphic control of different areas and correlation of the sites. Therefore, McDougall & Brown, (2006) noted that the Okote Tuff, the characteristic tuff delineating the Okote Member has deposited at 1.56+_ 0.05 Ma. Additionally, in Area 130 for example, the exposed Orange Tuff that was characteristic at FxJj18 was dated to 1.520 +- 0.005 m.y.a through 40Ar/39Ar dating (Lepre, 2017). Additionally, the extensive geographical exposure of the Okote tuff within the Koobi Fora Formation throughout the Karari region allows the correlation of dates with other sites as well as the reconstruction of the range of habits and activities across the paleo-landscape at a discrete spatial scale. In this study, I focus on the Lower Okote Member of the formation dated to 1.6-1.5 Ma.

3.3.2 The Karari Industry

Karari Industry is a local name given by Harris and Isaac (1978) to refer to the local variant of the Developed Oldowan Industry. Isaac et al. (1997) linked the Karari Industry to the Developed Oldowan A that had been defined from other archaeological sites such as Olduvai George, Tanzania (Leakey, 1971). The Hallmark of the Karari Industry is a single platform core also known as the Karari scrapper (Rogers et al. 1994; Braun et al., 2008). It is as a result of this, that the sites under study such as the FxJj18, FxJj20, FxJj23, and FxJj50 have been reported to represent the Developed Oldowan; also Karari Industry due to the following factors; their assemblages are dominated by an abundance of artifacts, prominence of the Karari scrappers, as well as the large amounts of artifacts types.

Harris (1978) categorized the Karari scrappers into two distinctive divisions of stone artifacts including core or core tools, and flakes. Additionally, according to Isaac (1976b), this was the earliest known stone assemblage in which two families of artifacts forms could be distinguished i.e. the core tools and flake tools. As a result of such divisions within the Karari Industry, it is evident that like any other industries i.e. Middle Stone Age and Later Stone Age that have significant variations, the variations within the Karari industry are undeniable. These variations in the lithic assemblages might be attributed to both the differences in site function in procurement and use of critical resources as well as the differences in reduction tactics including raw material procurement, use, transport, and the degree of reduction, however, these remain unclear.

It remains unclear whether the variations within the Karari Industry resulted from the existence of three different hominid species that co-existed in the paleo-landscape setting

(*Australopithecines, Homo erectus, Homo habilis*), (Wood 1991) or not. A detailed study of the variations reported by Harris (1978) within the Karari Industry remains scarce. Therefore, studies not only in artifacts size differences as well as composition and character of the assemblage, would without a doubt inform about the early hominids' life-ways and settlement patterns during the early Pleistocene period. This topic is central to my MA thesis which was based on the materials from the sites housed at the National Museums of Kenya.

3.3.3 FxJj18 IH

Harris (1978) noted that this is one of the smallest of all the other three excavated sites in the region. Archaeological materials recovered were excavated from an 11-square-meter area. It is one of the other three archaeological horizons in the area that make up the FxJj18 complex. The materials recovered from the site were attributed to proximal floodplain sediments and within the beds of the Okote Tuff Complex. Irrespective of its small size, the site is considered the densest of all the sites known within the Koobi Fora formation after 3100 stone artifacts were recovered from the site. Additionally, it formed the descent localized cluster of the sites within the Karari paleo-landscape. The unbraided and fresh nature of the artifacts led to the conclusion by Harris (1978) that even though the post-depositional processes might have been responsible for the high clustering and the high density of the artifacts, the assemblage had not been moved by fluvial post-depositional processes. In association with the artifacts were hundreds of bones recovered representing at-least seven mammalian families as well as a catfish.

3.3.4 FxJj50

Unlike the FxJj18 HIS, this is a very large flood plain site located in area 131 near the southern edge of the Karari Escarpment. A very large excavation of 200 square meters was done in the 1970s and yielded a rich archaeological assemblage of 1400 stone artifacts as well as 200 bone specimens. At the base, the site is characterized by fine-grained basal sediments. In addition, bones of diverse mammalian species were also recovered. Bunn (1980) argued that a wide variety of animals except the carnivorous, rhinoceros, elephants, and bovids are well represented at FxJj50. Other grassland animals such as equid and suid remains were recovered from the site. In addition, large browsing herbivores and large aquatic Hippos are also well represented.

Unlike other sites within the Karari, FxJj50 has very compelling evidence of hominids' involvement at the site with the animals present. Several distinctive pieces of evidence include hammer-related fractures pattern on the bones as well as artifact-induced cut marks. A similar pattern was reported elsewhere by Bunn, (1984). He noted that lithic transport out of the site for use elsewhere was a common practice by the early hominids. This is very evident at a site in area 103 of the Koobi Fora ridge whereby cut-marked bones were recovered with no associated artifacts and led to the conclusion that early hominids were transporting stones for use elsewhere, they might also have used them opportunistically or even saved others for future use. This might help in understanding the dynamics that led to the accumulation of artifacts at the site FxJj50. Further, the recovery of cut-marked bones at Gaji 5 (a site located in area 103) with no associated artifacts ramifies the idea that the availability of stone played a critical role in dictating the foraging strategies of the tool using hominids. Therefore, it has been argued that from the sites, hominids were able to occupy different environmental settings including wet and dry climatic conditions. Hence the Karari industry as well as their discard patterns reflect the adaptations of the early hominids to the diverse environmental conditions at the time.

New bundles of evidence, for instance, have revealed that FxJj50 was more suitable for hominids to keep returning to the site given the availability of diverse raw materials as well as the availability of diverse animal species. As a result, Schick (1987) hypothesized that hominids anticipated the need for stones in the areas that had an abundance of food resources whereby they accumulated the stones in these particular spaces. The stones were not removed from these favored places therefore since they anticipated they would use them to forage at a nearby location. The extent of the excavated area at FxJj50 is shown on the plate below. Clear markers of the excavated surface are not clear due to erosion that has backfilled some excavated spaces.

Plate 3.1: Photograph showing the location of site FxJj50, the arrow pointing to the excavated surface

3.3.5 FxJj23

This is a small archaeological locality located in area 133 of the back slopes. The excavated materials were recovered in the Okote Member deposits. A small excavation revealed 129 stone artifacts and a variety of animal bones. A study of artifacts from this site was critical as it would allow documentation of hominids' activities in tool manufacture, use and discard in a different Paleo-geographical setting within the Turkana basin. This is because this site is close to the basin margin, hence, allowing for plentiful sources of basalt boulders and cobbles. In addition, it is important as a comparative sample to understand how early hominids responded to this stone availability in comparison to other areas where these raw materials were very scarce and were only available in small clasts.

The two plates below put the site FxJj23 into a modern landscape setting by showing a contrast between the excavated surface and the rush green vegetation in the background. The background from the second plate shows the western margins of the Karari escarpment. The subsequent figures provide more details on the map of Kenya with an inset of the study areas as well as a final figure of the specific sites within a 72km space.

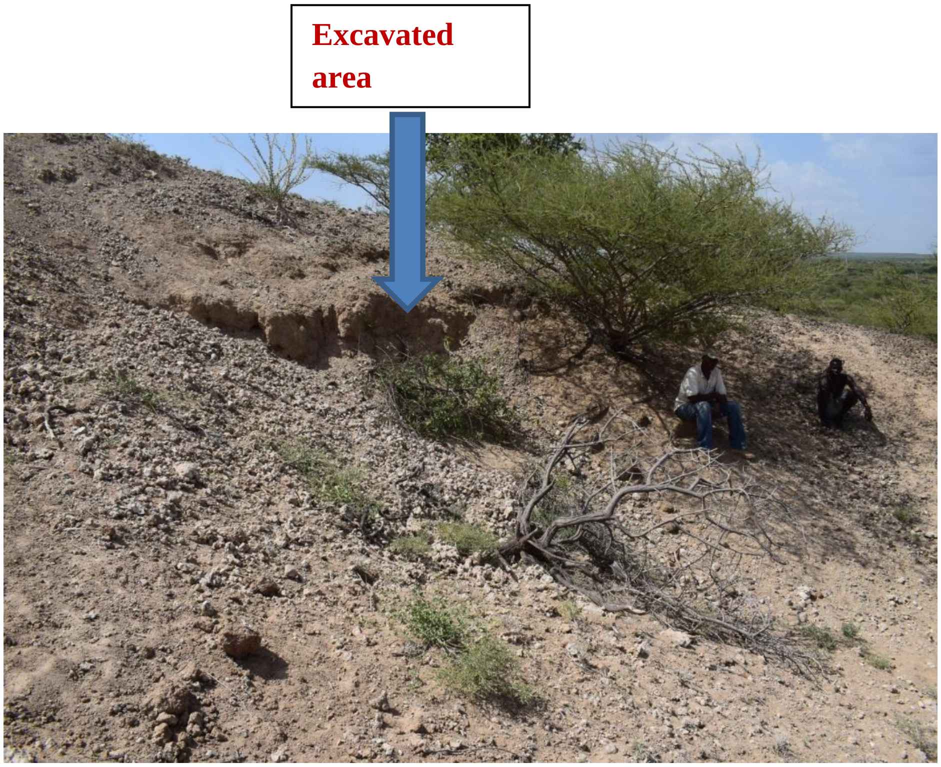


Plate 3.2: Showing excavated area at FxJj23

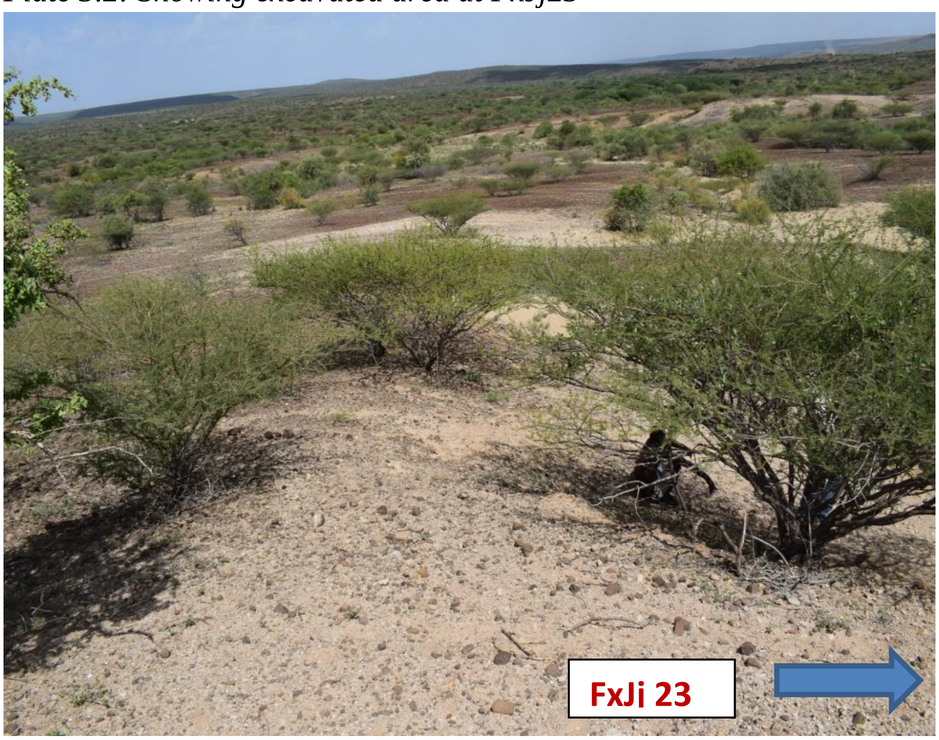
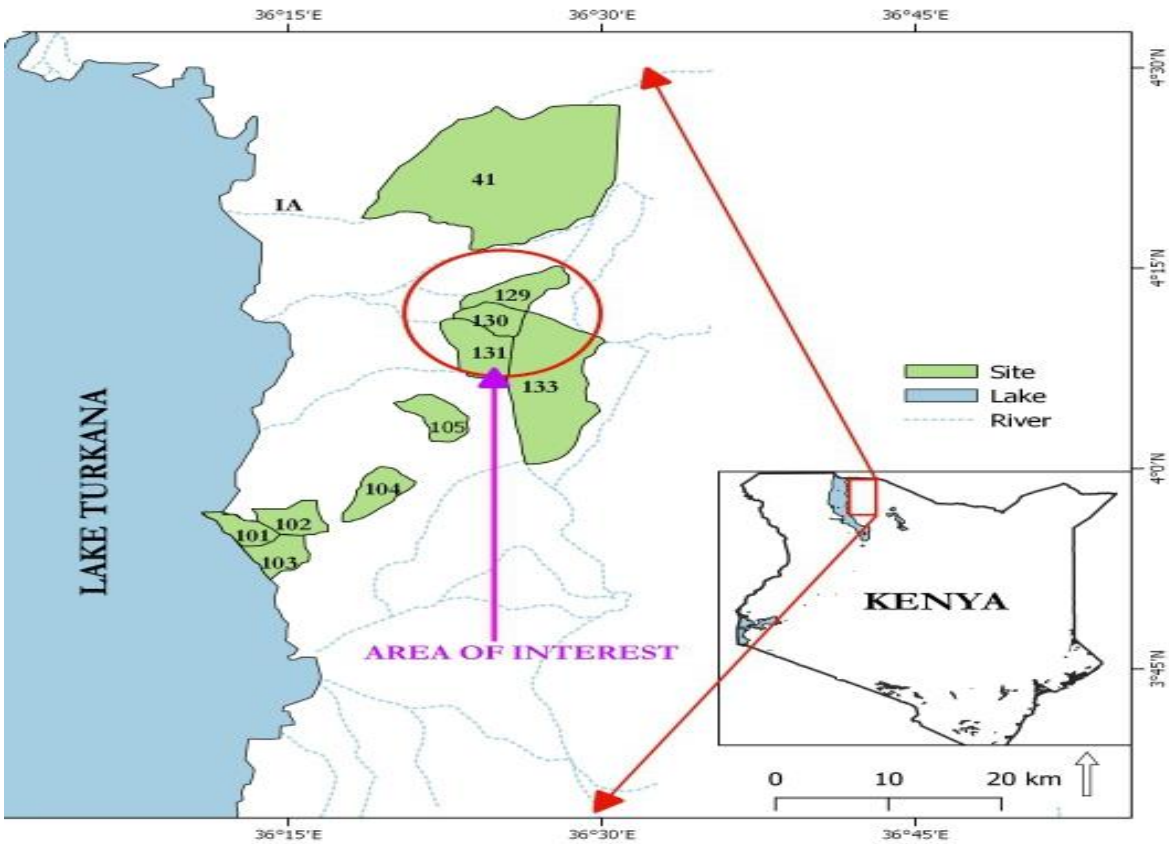


Plate 3.3: Showing the location of FxJj23 on the modern landscape, the ridge represents the western boundaries of the Karari escarpment where other sites; FxJj50, 18, and 20 are located.



F*ig 3.3: A map showing the 72km square area where the study sites are located. Inset; showing sites under study. FxJj23 is located in area 129, FxJj 18 HIS in area 130, FxJj 20 E in area 130 while FxJj50 in area 131*

Source: Adopted from google

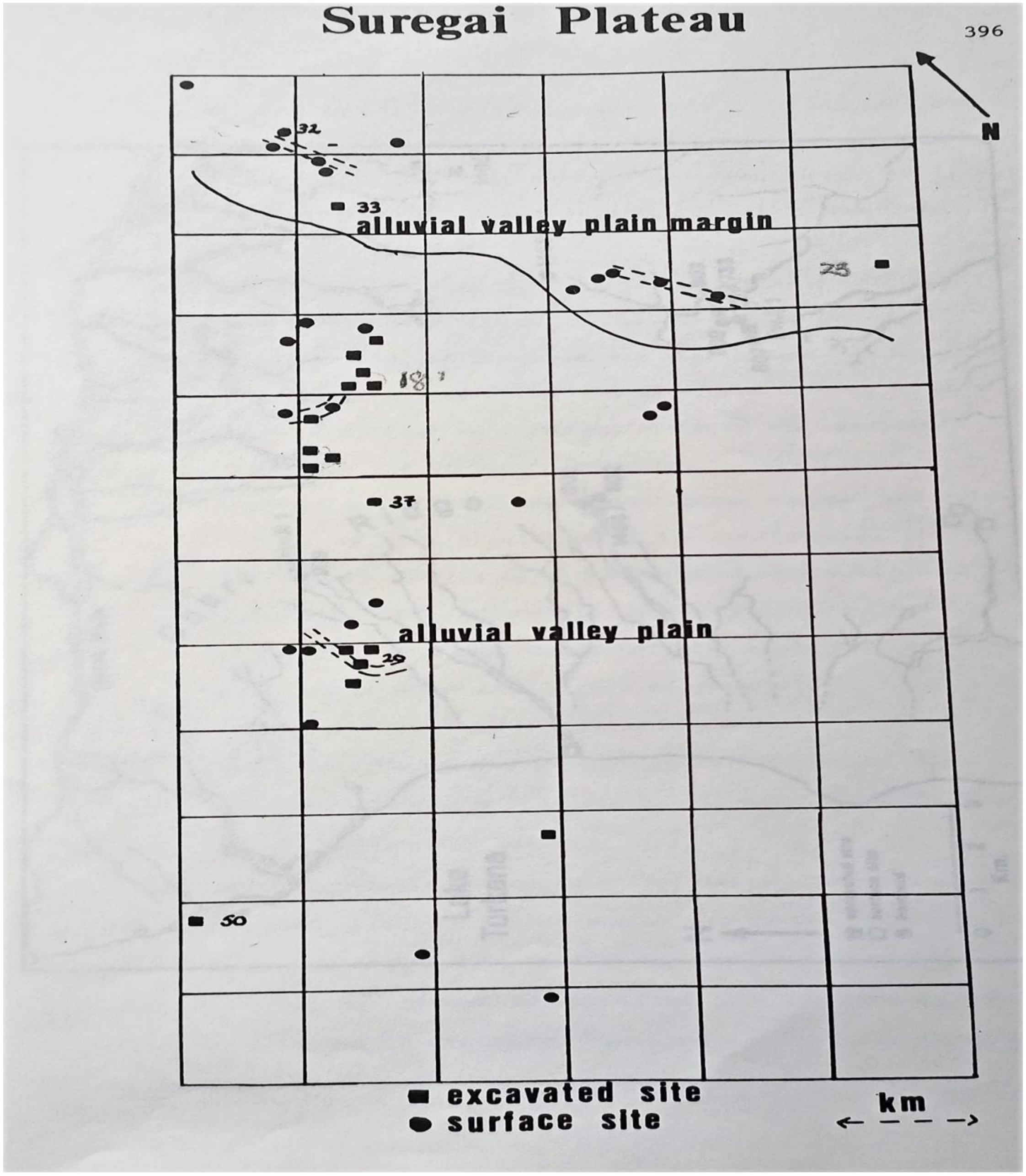


Fig 3.4: Showing the distribution of the FxJj23, FxJj20E, FxJj50, and FxJj18IHS within a 72 km area. Surgei Cuesta (Raw material source)
Source: Fiebel (1991)

3.4 Conclusion

This chapter has put the study area into context by informing about the paleo-vegetation of the sites under study, dating, as well as comparing these paleo-landscapes to the modern geography of the karari escarpment. It has informed in detail about the past and present vegetation with inferences made on how the changes in this vegetation might have impacted the hominid's behaviors. In addition, a detailed description of the geography and the sites has provided a footing within which patterning of human behaviors can be made right from site differences in recovered materials to the final analysis in this study. Photographic images, maps and other figures used in the chapter paint a picture of the main aspects addressed, including modern vegetation, geography, and the location of the sites in relation to one another. Also, in the chapter, I have shown that variations exist between the sites beyond the final analysis, their location in the paleo-landscapes is a huge emerging factor. Overall, this study was based on materials from sites that have been discussed in this chapter as part of this conclusion.

CHAPTER FOUR

RESEARCH METHODOLOGY

4.1 Introduction

This chapter discusses the methods of data collection and analysis. Data sets used in the study were gathered through observation and recording of several attributes including raw material types, flake types, platform types, amount of cortex, and unmodified cobbles. Data analysis from the four sites was done through R- programming. This chapter aims at describing in detail the sampling techniques used and methods of data collection and data analysis. The chapter is divided into three parts; data collection techniques, Sampling, method of data analysis as well as the concluding part.

4.2 Research Design

In this study, both probability and non-probability sampling techniques were used. Probability sampling was used in the selection of the artifacts sample from the four sites while non-probability sampling was used in the choice of study sites.

4.3 Sampling Technique

Sampling being very vital in archaeology embodies the idea of using information gathered from part of the assemblage to make inferences on the whole. A purposive sampling technique was used in the choice of study sites. The selection of the study sites through purposive sampling ensured that only the sites with distinctive features were selected. Their location on the paleo-landscape, the density of artifacts recovered, and recent pieces of evidence recovered from the sites were the main factors considered.

The key sites under study are located within an area of 72 KM square, a large surface area hence it was crucial to use a purposive sampling technique in then choice of different sites that covers this area. For instance, site FxJj23 was selected because of its proximity to the basin margin. In contrast, FxJj18 IHS was selected since it is the densest of all the available Karari sites. Moreover, FxJj50 was selected because of its location at the furthest distance from the raw material source (about 20 km away) (Braun, 2009). Finally, FxJj20 E was selected due to the recently available evidence that relates it to the earliest evidence of palm trees and fire (Harris, 1978).

A systematic random sampling technique was used in the study to select a sample of 500 artifacts from the population for every site. Using systematic random sampling in the study ensured that every artifact was given an equal chance of being selected. In addition, it ensured that the selected sample was representative enough and the results obtained would be confidently used to represent hominids' behaviors on a wider landscape scale. Hence, a total of about 500 artifacts were selected for analysis apart from FxJj23 which had the least artifacts population of 129 pieces. For instance, to get the 500 study samples from FxJj18 IHS, all 3231 pieces were arranged randomly in wooden trays. The next stem involved dividing the population as nit had been reported by Harris (1978) of 3231 artifacts by 500 which resulted in 7. Therefore, for this site, every 7th artifact was randomly selected from the randomly arranged stone artifacts in the trays where a final study sample was recovered.

In sites FxJj20 E and FxJJj50, a similar procedure was followed, and by dividing the population from the two sites by 500, every 3rd position piece of the artifacts was randomly selected. For site FxJj 23, the smallest in terms of the number of artifacts and was included in this study for comparison purposes, the entire population was analyzed. The systematic random sampling technique was employed in this study not only because it offers a representative sample of the whole but also because it reduces bias significantly by ensuring that every artifact is given an equal opportunity of being selected.

4.4 Data Collection

Early Stone Age sites are found more frequently along with the water sources, rivers, and springs and their tool assemblages are relatively uniform, (Harris 1978). Therefore, the reanalysis of archaeological stone artifacts excavated in the 1970s by Harris is vital in reassessing these kinds of patterns of behavior of the early hominids. The study used a methodology suitable for generating two types of data. First, it aimed at generating relevant data to recognize intra-site patterns of manufacture sequences of the stone artifacts from four sites FxJj18 IHS, FxJj20 E, FXJj23, and FxJj50. It was also geared towards generating relevant data to recognize inter-site patterns by comparing similarities or differences of the stone assemblages across sites.

The study population used in this project was archaeological assemblages from the key study sites (FxJj18, FxJj20, FxJj23, and FxJj50). All artifacts from the sites including flakes (broken, whole), cores, cobbles, and angular fragments were all considered for analysis. However, due to the high yield of artifacts from the sites, that were available for analysis, a systematic random sampling method was used to select a suitable sample and a more representative sample for the study.

4.5 Methods of data collection

Data that was used in this study was obtained from excavated materials form Koobi Fora, East of Lake Turkana. These materials were originally excavated in the 1970s and are housed at the

National Museums of Kenya. To describe and analyze the lithic remains from the Karari Escarpment, the assemblage was divided into several lithic classes. While other researchers such as Leakey (1971) have defined an elaborate system typology based on the morphology and function of stone artifacts in describing artifacts, little attention was paid to flakes and flake fragments or debitage. This study goes beyond the functionality and morphological differences of the lithic assemblages.

In analysis, Sullivan and Kozen's (1985) typological system that is "interpretation free" was used in the analysis of the debitage. Flakes were grouped into the following categories; whole flakes, flake fragments, broken flakes, or angular fragments. The classification criteria for a single piece of flake included the presence of a platform (point of the applied force), the presence of a single interior surface (Ventral), and the presence of complete margins. If the debitarge lacks a single ventral surface, then it was classified as debris and no further analysis was done. An evaluation of the platform was done and if it lacks a platform, the flake was classified as a flake fragment. If a platform is present, the analysis continued to determine whether the margins are complete or lacking. If the margins are broken, the flake was labeled as a broken flake and a complete flake if the margin is complete, after which, detailed measurements were taken and recorded.

In acquiring other aspects of the data for the study, several artifacts attributes were thoroughly investigated including raw material types, artifacts size, amount of cortex, Toth types, platform types, flake types, bulb of percussion, dorsal flake scars, and unmodified cobbles. The first step included recording raw material types, and measurements of size and weight by recording length, width, and thickness after which other details were recorded.

Understanding the amount of cortex was crucial in understanding hominid behavior in the procurement, use, and discard of lithic tools. This was done by recording the amount of cortex present on the artifacts across the sites. The amount of cortex was recorded by estimation in the following scale; 0,10,20,30,40,50,60,70,80,90,100. Platform-type details were recorded on flakes including single-faceted, double-faceted and multi-faceted. Recording details on the bulb of percussions was crucial in providing an understanding of techniques involved in tool manufacturers such as soft hammer, hard hammer, and bipolar percussions. Therefore, the bulb types recorded included thick, prominent, and flat bulbs.

In addition, artifacts types and unmodified cobbles including flakes, cores, and angular fragments details were also observed and recorded. There details provided an opportunity for comparing how these compositions compare across sites. Toth types were recorded by assessing the reduction stage of every artifact. This mainly applied to the detached pieces where flakes were grouped into six categories. Different Toth types were recorded in the following manner.

- Stage 1- Dorsal surface and the platform are fully cortical
- Stage 2 - Dorsal surface is partly cortical with the platform fully cortical
- Stage 3- Platform fully cortical and non-cortical dorsal surface
- Stage 4- Dorsal surface is fully cortical and the platform non- cortical
- Stage 5 - Dorsal surface partly cortical and platform non-cortical
- Stage 6- non -cortical dorsal and platform surfaces.

Some of the research instruments used in this study included a pair of calipers used in taking measurements such as length, thickness, and width. Also, a camera was used in taking several photographs of the collections that I have attached in the next chapter.

4.6 Data analysis

The data that was collected from this study were analyzed using linear regression and R-programming after which subtle variations in the shapes and sizes of the chipped stones artifacts were identified. Some of the commonly measured traits included maximum length, thickness, and maximum width. The different raw material types were also compared across sites (that is which of the sites showed dominance in exploitation use and discard of exotic raw materials). Other attributes were also compared across sites including, flake types, platform types, and distribution of the amounts of the cortex.

From the results, a comparison was made on the bases of site patterning in relation to assemblage character, composition, and density to reconstruct hominids' behavior, settlement patterns, and cognitive abilities as reflected in the study findings. The data gathered was represented in histograms and pie charts to allow easy comparison across sites.

4.7 Conclusion

The methods of data collection described above including the metrical measurements aimed at providing less biased results from the analyzed materials. When doing these measurements, the process was repeated three times to ensure that the best results were recorded. This is because measurements provided by the calipers vary significantly. A combination of two analytical techniques; R- programming ensured less biased results were provided (see appendix 1)

CHAPTER FIVE

DATA PRESENTATION

5.1 Introduction

This chapter describes the stone artifacts assemblages analyzed in detail. The chapter covers the basic attributes of the artifact types, sizes, reduction sequence, and densities so that a comparison can be made across the key sites. It focuses on the descriptive attributes of the artifacts that shed light on the factors involved in the formation of these assemblages. Factors such as taphonomical processes involved that led to assemblage discard and burial have been reported. In addition, post-depositional alterations, and technological processes which were employed by the hominids that created the artifact assemblages have been reported in this chapter. Histograms and pie charts used in the chapter create a visual representation of the commonalities and variations across the sites in tool manufacture, use, and discard patterns.

5.2 Raw Materials

The stone tools described from the study sites were mainly made from river-worn cobbles found in the ephemeral streams that drained from the basin margin. Harris (1978) noted that most of the stones in the Karari escarpment were medium to fine-grained basalt, or trachyandesite. Other materials included ignimbrite, rhyolite, welded tuff, and chalcedony quartz and chert even though their prevalence on this landscape is very rare. The results from this study reinforce this argument by Harris, (1978) that the availability of water played a critical role in providing resources such as water, fruiting trees, and transporting raw materials. Therefore, the most predominant raw material type from all the sites is Greyish grey basalt with more than 60% representation. FxJj18 IHS is the leading site in the representation of grey basalt with over 80%

frequency. In general, the site exhibited a high dominance of this raw material type compared to other types. Compared to other sites, FxJj50 had the least 45 % representation of grey basalt with both FxJj23 and FxJj20E exhibiting over 75% representation. Blackish grey basalt and reddish brown basalt follow behind closely in terms of representation across the sites with FxJj50 having the highest frequency of these basalt variants.

In comparing the degree of procurement and use of exotic raw materials, FxJj50 takes the lead. For example, the site has the highest frequency of black chert raw materials artifacts with a 12 % representation. Other sites exhibited only a 1% representation of the same raw material. A similar pattern has been exhibited in the frequency of other raw material types including ignimbrite, chalcedony, and quartz. FxJj50 takes the lead with more than 1% representation of these exotic raw materials (chalcedony, ignimbrite, chert, and quartz) while in the other sites, the majority of these raw materials types are missing in the assemblages. For instance, across the three sites, FxJj23, 18, and 20 E, raw materials such as phonolite quartz, chalcedony, and ignimbrite, are conspicuously missing.

This data is vital in answering the question regarding hominid behavior in the procurement, use, and discard of exotic raw materials as represented at the sites. The acquired data clearly shows that hominid behavior varied across sites in procurement and use of exotic raw materials. Partly, this might have been due to the proximity of the types of raw material at the sites. In addition, this might be attributed to hominids' cognitive ability to recognize the durability of basalt raw materials and abundance, hence using it in huge numbers. Patterns of exploitation and use of exotic raw materials at FxJj50 compared to other sites might be associated with hominids' knowledge and appreciation of their durability, flakability, and ability to produce sharp edges.

Recovery of the highest number of cut-marked bones at this site and none in other sites attest to these observations, (Bunn 1982)

From the sites under study, similar frequencies and the presence of such raw materials have been replicated on the archaeological assemblages in previous studies. This implies that hominids might not have been procuring some raw materials over others. Rather, the prevalence of basalt raw material in archaeological assemblages from Koobi Fora is also reflected in the samples described in this dissertation in several sites, basalt represented 90 % of the lithics.

Table 5.1 below shows the distribution of different raw material types across study sites. Fig 5.1 shows a graphical representation of these distributions of raw materials across the sites. In addition, plate 5.1 is a photograph showing the diversity of procured raw material types across the study sites.

RAW MATERIAL TYPE	FxJ18 IHS	FxJj23	FxJj20E	FxJj50
Blackish grey Basalt	29	26	83	94
Grey basalt	351	88	228	136
Reddish Brown basalt	10	14	33	7
Brown chert	4	3	6	38
Chalcedony	5	0	16	3
Phonolite	4	0	0	3
Grey ignimbrite	4	0	5	4
Whitish grey Basalt	16	0	2	2
Pink ignimbrite	1	1	0	0
Green chert	0	1	0	0
Quartz	0	0	2	5
Grey chert	0	0	0	8
Total	424	133	375	325

Table 5.1: Raw Material Types from Excavated Samples Sites

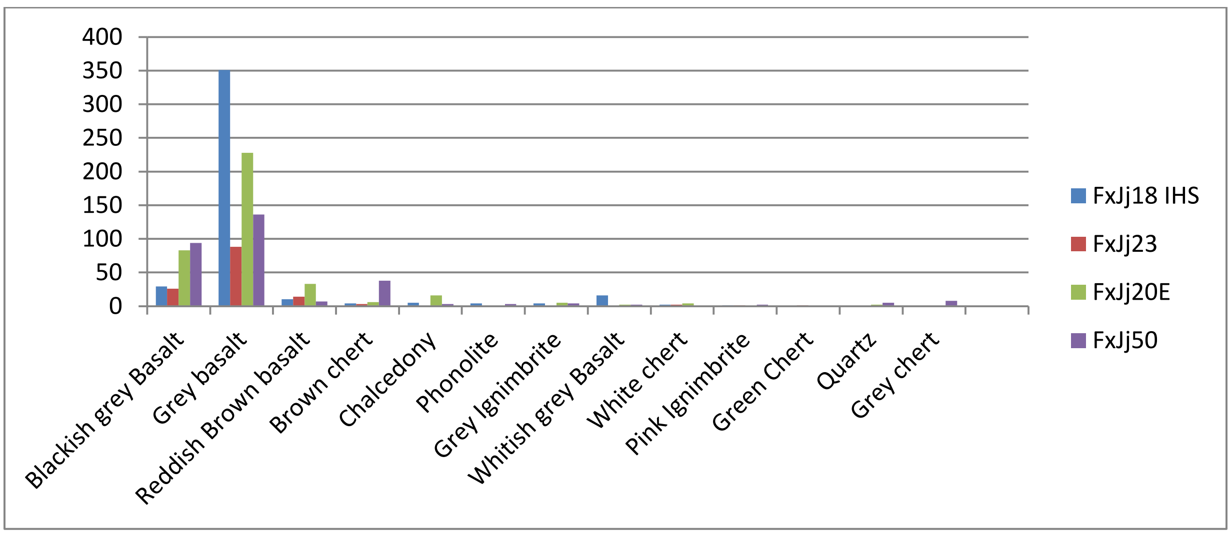


Fig. 5.1; a graph showing a representation of different raw material types across sites

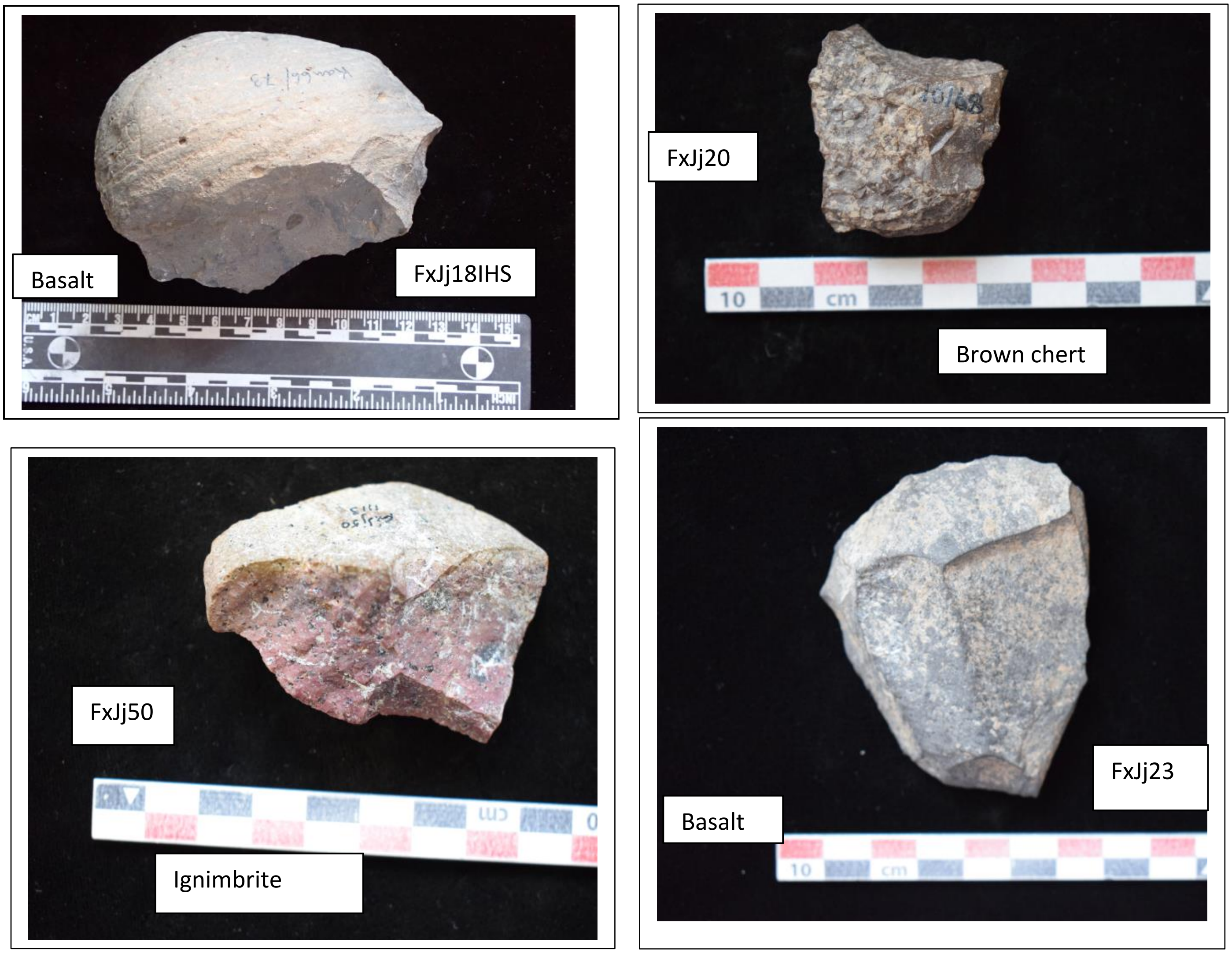


Fig 6.1: Plates showing variations in raw materials, amount of cortex, and flake size across the four sites

5.3 Size and weight of flakes

Length, thickness, and width of flake attributes are vital in this study as they allow for the measurement of the flakes. Results from such analysis reflect the production stages and the employed techniques during tool manufacture. For example, larger flakes are produced in earlier stages of reduction whereas small flakes are produced later. Additionally, size and weight reflect flaking techniques. The hard hammer percussion technique, for example, produces relatively large, bulkier flakes than those produced through pressure flaking and soft hammer percussion.

Previous studies have demonstrated that measurements of sizes and weight are very crucial as they inform about the flaking technique used and the reduction degree of every detached piece, hence site patterns across space. Isaac's (1986) "stone flow model" posited that the further away a site is located from the raw material source, the smaller the pieces that are produced at this site. This is based on the idea of "curation". According to him, hominids procured raw materials from the source, where the initial reduction was done. Consequently, the partially reduced cobble was transported on the landscape and used when the need arose up to the point of exhaustion and finally discard.

Metric analysis of this study has provided very surprising results. FxJj23 takes a lead with the longest artifact sizes with a mean of 53.60 mm. While this frequency in the mean can be attributed to the small sample that was analyzed from the site it is evident that the average sizes of artifacts from this site are undeniably long. Other sites including FxJj18IHS and FxJj20 E have close mean length frequencies of 30.67mm and 33.86mm respectively. These results provide an alternative argument about the site to those reported by Harris (1978). In his study, he maintained that FxJj20 was the last space in the reduction sequence characterized by the small exhausted cores. The result from this study does not agree with this argument since FxJj20E has a higher average, mean length than FxJj18 HIS.

FXjJ50 has the smallest average mean length of 21.32mm compared to other sites. Partly, these results were expected since the site is located at the furthest distance from the raw material source. The metric results from the study have no deviated from the expected patterns. FxJj23 has the highest mean frequency compared to other sites since it is the closest to the raw material sources, while FxJj50 has the lowest mean in terms of the length, width, and thickness as it is located at the furthest distance from the raw material source.

In addition, FxJj23 has the heaviest pieces with a mean weight of 55.30g compared to FxJj23 which has the least weight with a mean of 5.50g. In comparing the width and thickness mean, FxJj23 has the highest means with 42.61mm and 19.71mm respectively. FxJj50 has the lowest average width and thickness means of 18.16mm and 6.66mm respectively. Hence, the results are crucial as they partly answer one of the objectives on the commonalities and variations of lithic assemblages across sites. Significant variations and commonalities have been reported from differences in weight measurements to differences in length, width, and thickness measurements.

Fig 5.2 shows the distribution of mean lengths across the four sites. A huge contrast is represented especially between FxJj23 and FxJj50.

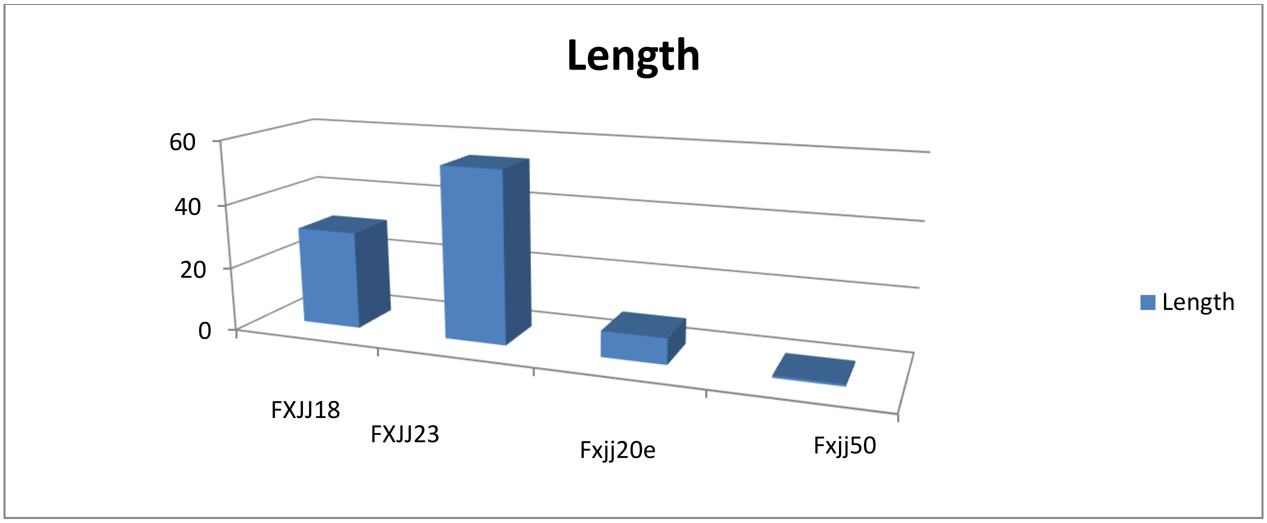


Fig 5.2: A graph showing the distribution of lengths across the study sites

5.4 Weathering stages

In lithic analysis, the overall condition of an artifact is very critical as it can relate to several factors: The amount of time the assemblage has been exposed on the surface and the degree of transport in a high-energy depositional environment. Also, the overall condition of the artifact informs about the intensity of the surface alterations before it was buried and the amount of time the assemblage has been lying on the surface.

In this study, two weathering processes were investigated: The post erosional surface exposure and pre-depositional surface exposure. The two processes are known to create a dull patina on the exposed surface of the stone. Since weathering processes can operate on a local scale and can be lumped into one artifact attribute, the study used this variable as an indicator of the absence of certain processes that might have affected an assemblage such as fluvial transport. For example, if the majority of artifacts in an assemblage are in their original color, then we may rule out extensive surface exposure of the artifacts. In addition, we may rule out post-depositional biological and chemical alterations that might have acted on the artifact during the post-depositional history of the archaeological assemblage. Hence the degree of weathering in the study was assessed on a five-stage scale.

1. Stage 1- very fresh sharp edges and visible ridges
2. Stage 2- very fresh edges but slightly rounded edges
3. Stage 3- slightly blunt edges and rounded ridges
4. Stage 4- blunt edges and partly visible ridges
5. Stage 5-blunt edges and completely rounded dorsal surface. No dorsal scars or ridges are visible.

Even though the rating scale is subjective, it was applied by Harris, 1978 and Stern 1991. For example, Harris used a three-stage scale that included fresh, slightly abraided, and abraided. Within this scale, Harris classified assemblages from FwJj1 as fresh and those from the FxJj18 complex as fresh to slightly abraided. In contrast, in his study of hominids' mobility patterns, Reeves (2019) used five weathering stages scale which this study relied on. My sample is quite different and no single pattern can be observed. For example, the majority of artifacts (more than 50%) from FxJj23, FxJj20 E, and FxJj50 fall within weathering stages 1 and 2 while 3/4 of artifacts from FxJj18 IHS fall within weathering stages 2 and 3.

The distribution of weathering stages for sites FxJj50 and FxJj20 reflect an expected pattern. Deposited in a flood plain context, 80 % of artifacts from the two sites fall within weathering stage 1 (WS) and WS2, a pattern that would be expected. This indicates that the materials were not exposed on the surface over a long time or were not transported over long distances before burial. However, the weathered nature of artifacts from FxJj18 IHS deviated as well as the flesh nature of artifacts from FxJj23 deviated from the expected pattern. Contrary to our expectation, that materials from 23 ought to be more weathered as they were recovered from a fluvial context, FxJj23 has 70% of its artifacts within WS1 and WS 2 and only 15% of the entire population from the site fell within WS 4 and WS 5.

In addition, FxJj18, one of the flood plain sites has more weathered artifacts compared to other sites. About 58% of the analyzed sample from the site fell within WS3, the highest recorded figure in this study. A similar pattern of size was observed by (Harris 1978 and Rogers, 1997). The weathering observed in FxJj18 IHS has been associated with chemical weathering reported at the site, due to the presence of calcium carbonate concretions recovered.

The results from this study partly help answer the question of the commonalities and variations of hominid behaviors as reflected by the assemblages. While it is difficult to read behavior using weathering stages, it is clear that different natural processes acted on the assemblages differently hence creating unique signatures. It might also mean that different artifacts were left on the surface longer than others hence increasing the rate of patination on them. Artifacts that were left exposed on the surface for longer offer a good opportunity for reuse compared to those that were buried immediately after discard.

This unique patterning of early hominids' behavior as represented in the assemblage is reflected in table 5.2. Subsequent figures Fig. 5.3, 5.4, 5.5, and 5.6 shows the distribution of the five weathering stages on individual sites while fig 5.7 compares the distribution of weathering stages as reported from the four sites.

Weathering stages	FxJj23	FxJj18	FxJj20	FxJj50
Stage 1	45	31	115	104
Stage 2	42	101	131	137
Stage 3	27	200	89	55
Stage 4	20	11	20	10
Stage 5	1	0	3	2
Total	135	343	358	308

Table 5.2: A table showing differential weathering stages across the four sites, FxJj18IHS takes the lead.

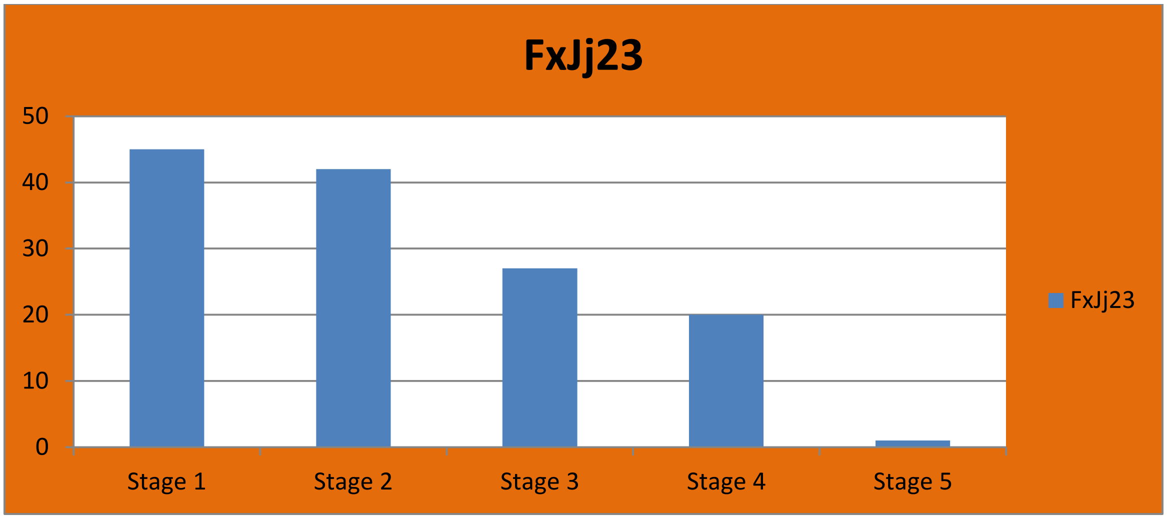


Fig.5.3. a graph showing the distribution of five weathering stages at site FxJj23

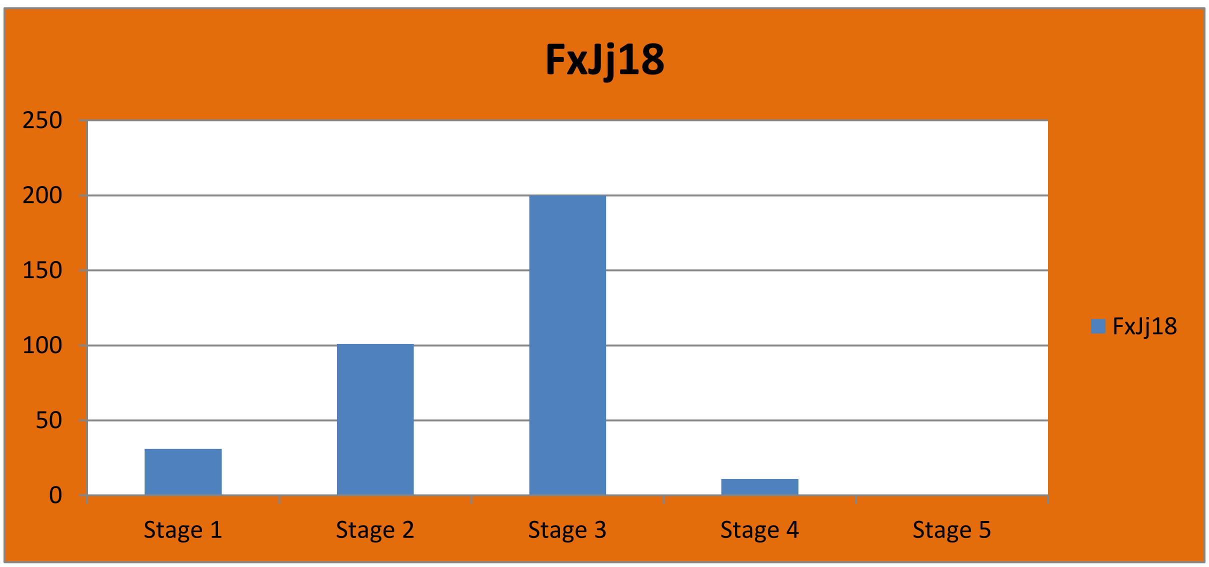


Fig.5.4. A graph showing the distribution of the five weathering stages at site FxJj18 IHS

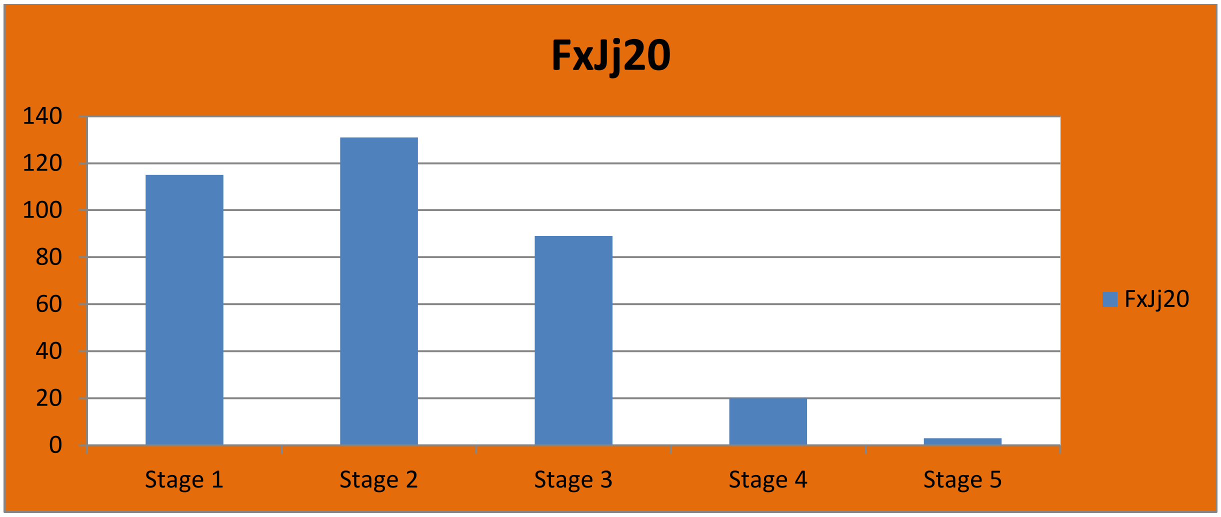
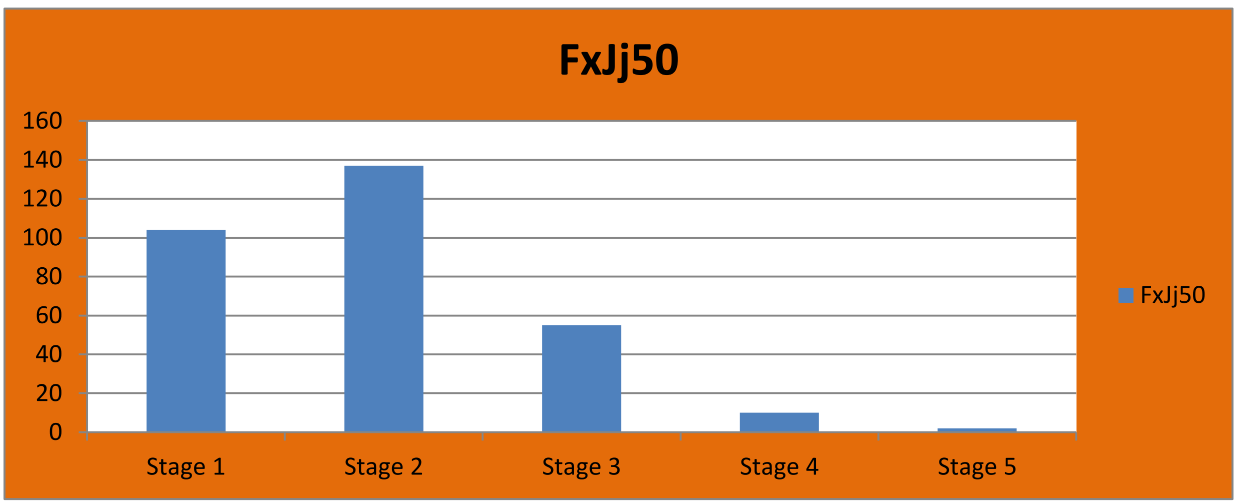


Fig 5.5. A graph showing the distribution of the five weathering stages at site FxJj20 east



5.6. A graph showing the distribution of the five weathering stages at site FxJj50

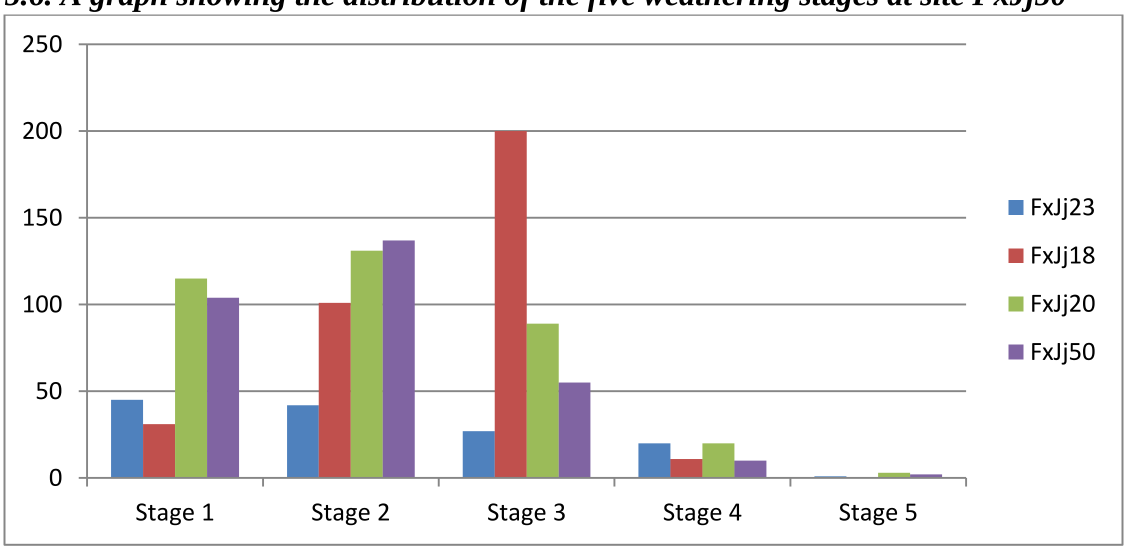


Fig.5.7 A graph showing a comparison in the distribution of the five weathering stages from the four study sites

5.5 Flake type

Stone artifacts from the Okote Member represent the life-ways of early hominids in diverse settings. Therefore, this analysis allows the Okote Member to be viewed in a manner that demonstrates the selective pressures and uses that acted on a tool hence mediating their behaviors. Even though transport was common at the time, refitting studies, (Schick, 1987) have demonstrated that the flaked pieces were commonly transported from one locality to another. Therefore, these dynamics are likely to impact the overall character and composition of the assemblage. In addition, these dynamics also impacted the type of flakes left behind by the early hominids. In this regard, the dominance of primary flakes in a site implies less “curation” while the dominance of tertiary flakes implies high “curation” from one site to another. This study has revealed unique results on flake types. For instance, FxJj50 one of the sites located at the furthest distances from the raw material source has the highest frequency of primary flakes with 106 (51.4 %).

In addition compared to the other three sites, FxJj50 has the lowest value of tertiary flakes at 18% and 30% secondary flakes. In contrast, all the other three sites have the highest frequency of tertiary flakes compared to primary and secondary flakes. For example, on one hand, FxJj18 IHS has the highest frequency of tertiary flakes across all the sites with 55.9 % representation, 30% secondary flakes, and about 14% primary flakes. On the other hand, FxJj20 E has almost similar frequencies in the number of primary flakes to that of the tertiary flakes with 36.39% tertiary flakes and 35.0 % primary flakes. Interestingly, one of the sites, FxJj23, located at the closest distance to the raw material source has a higher number of tertiary flakes compared to primary flakes. The site has 53% of its assemblage as tertiary flakes with primary flakes and secondary flakes representing 30% and 9% respectively.

The pattern reflected in this study follows the expected results for sites FxJj18 HIS and FxJj20E. However, the results from Fxjj50 and FxJj23 were not expected. Located at the furthest distance from the raw material source, it is expected that 50 would have higher frequencies of tertiary flakes than the primary flakes, the contrary has been observed. Also, results from FxJj23 deviate from the expected pattern. Located at the closest distance from the raw material source, it is expected that FxJj23 would have the highest frequencies of primary flakes and fewer tertiary flakes. Possible explanations for this deviation from the expected pattern include that due to its location in a fluvial setting, artifact sorting transported smaller cortical flakes away leaving huge none cortical ones.

The figures and tables below create visual representations of these distributions of primary, secondary, and tertiary flakes across the key study sites. For instance, Table 5.3 shows the frequency in the distribution of the three flake types across the four sites. Fig 5.8 shows the graphical representation of these patterns in relation to flake types across the key sites. The subsequent figures (5.9. 5.10, 5.11) show a representation of each flake type across the four sites.

Flake Type	Site Name. FxJj50	%	FXjJ23	%	FxJj18IHS	%	FXjJ20 E	%
Primary	106	51.4	30	32.26	72	25.81	93	47.69
Secondary	64	31.08	13	13.98	51	18.27	7	3.58
Tertiary	36	17.48	50	53.76	156	55.91	95	48.72
Total	206	100	93	100	279	100	195	100

Table 5.3: Showing frequency in the distribution of three flake types across the sites FxJj50, FxJj23, FxJj18 IHS, and FxJj20E

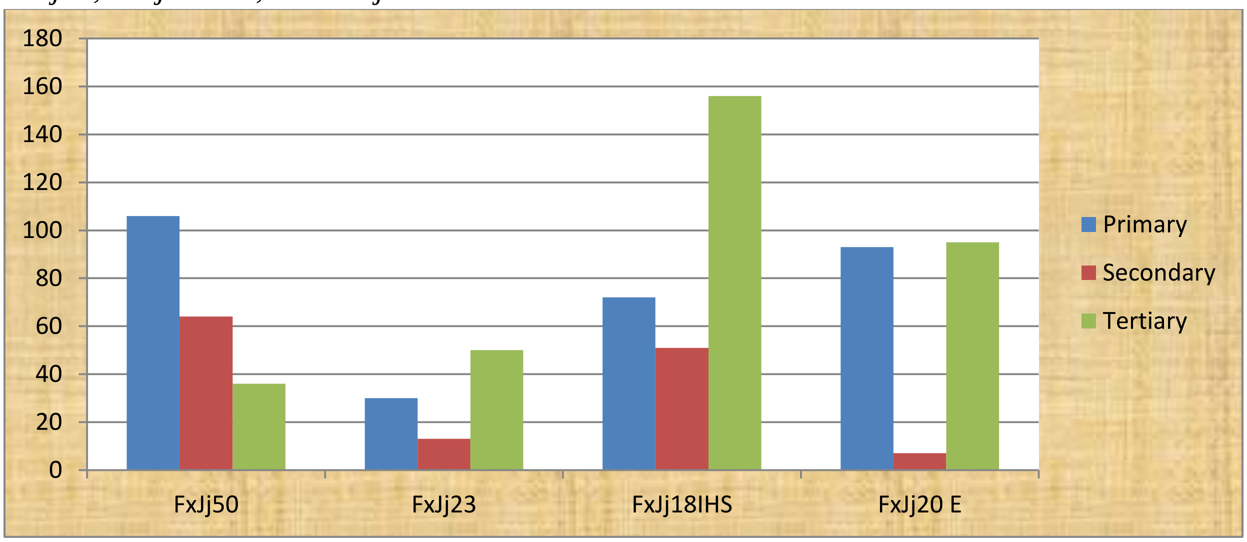


Fig.5.8. Distribution of different flake types across the four sites

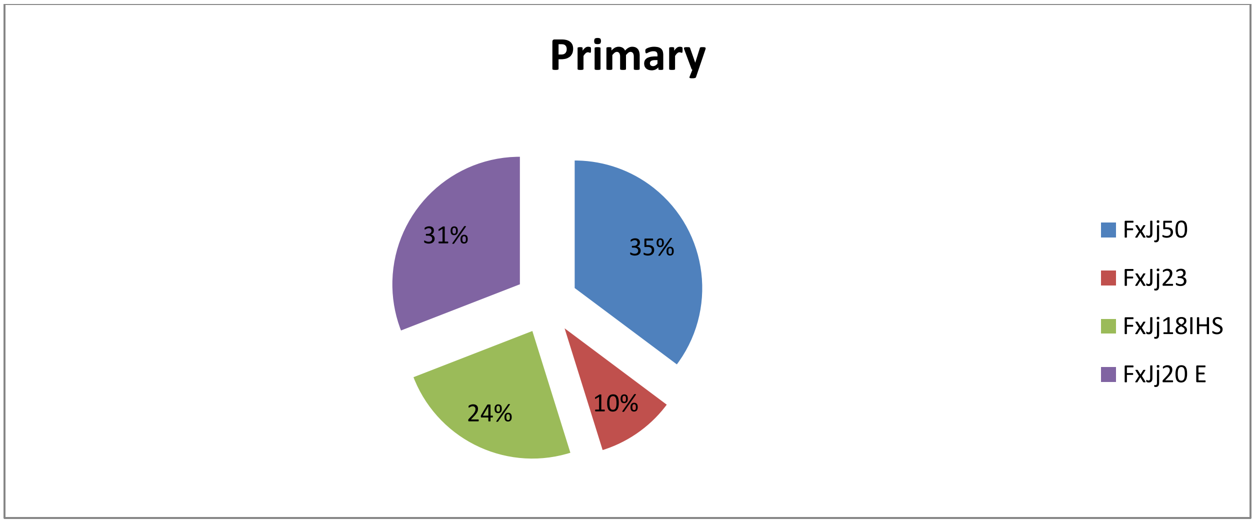


Fig.5.9. Percentage representation of the primary flakes in the four sites

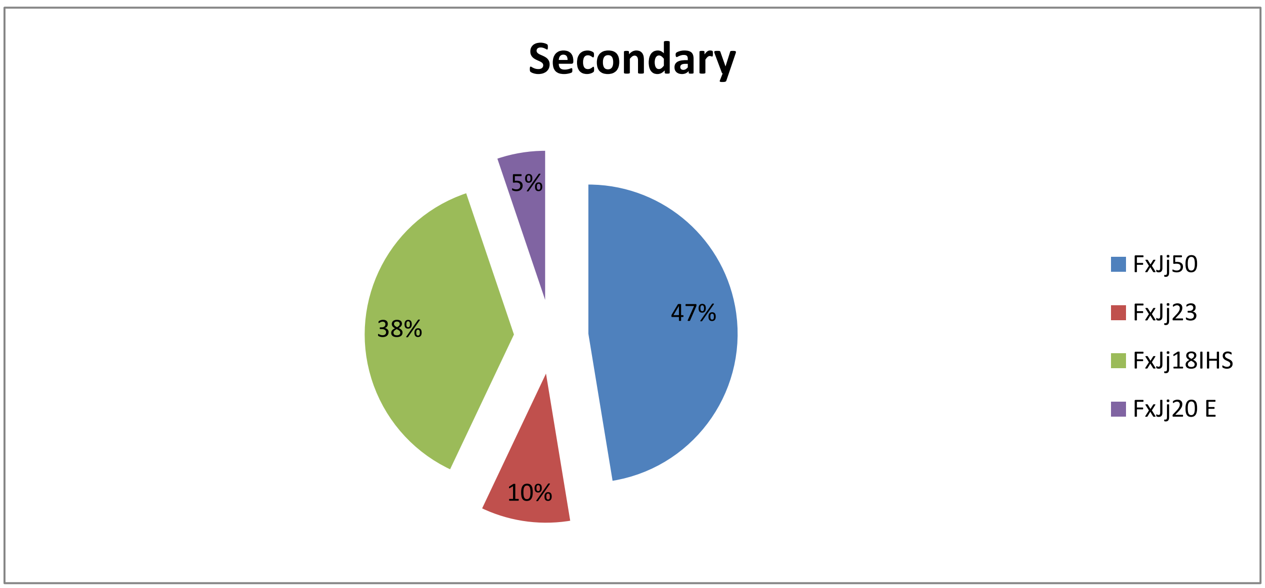


Fig5.10. Percentage representation of secondary flakes across the four sites

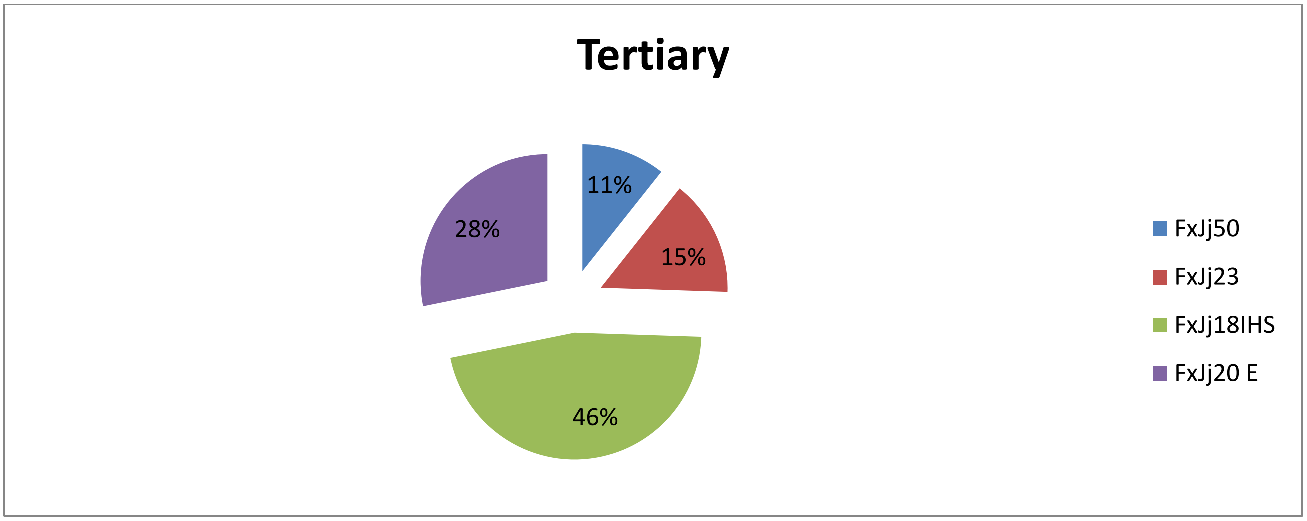


Fig5.11. Percentage representation of tertiary flakes across the four sites

5.6 Termination type

In this study, different types of flakes were identified and studied in detail. They included feathered flakes, hinged flakes, and step flakes. While identifying hinged flaked within an assemblage is very easy due to their distinctive rounded nature at the distal end, reliably distinguishing stepped flakes from broken ends is difficult. This is because, distinguishing between those that resulted from reduction processes, from those that have been broken through fluvial action, trampling, and soil movement does not appear possible when using an archaeological assemblage. In addition, the multiple knapper problems significantly affect the overall character of the assemblage. In an archaeological assemblage, it is argued that multiple knappers over a potentially long time could work on a single core hence leaving false skill signatures. One of the assumptions made in this study, therefore, was that just like any other termination type that is hinge and feather; stepped flakes resulted from the knapper's ability and skills to reduce cores. In his experimental studies, Ludwig (1999) argued that, during lithic manufacture, skilled snappers tend to produce more whole flakes and fewer stepped flakes than their novice counterparts. Therefore, the more step fractures on cores and step terminations on flakes in an assemblage, the less skilled the makers of that assemblage.

While FxJj18 IHS had the highest number of analyzed artifacts from the selected sample due to its huge population, FxJj50 has the highest number of feather termination flakes, 82.6 % of these flakes fall within this category of flakes. FxJj23 follows behind closely with a 78.4% representation of flakes with feather terminations. In addition, in FxJj23, 5.7% of flakes have broken termination types, 4.8% hinge terminations and 6.7% fell within step terminations. However, FxJj20E and FxJj18IHS gave unexpected patterns. From these sites, feather termination flake values are close at 73.9% and 55.14% respectively. In comparing broken flakes across the sites, FxJj18 IHS has the highest with a 28.3% representation compared to 7.2% for FxJj20E, FxJj23 had a 5.7% presentation, and 2.27% from FxJj50 broken flakes. FxJj23 has the highest hinge terminations with 20.45% compared to the lowest figure of 4.8% from FxJj50.

While at this point it is impossible to make conclusive arguments on the flaking techniques used across the sites, it is evident that the high number of feather terminations might have resulted from the knapper's skill and proficiency as well as the flaking techniques employed. However, these results will be used to compliment other attributes that have been investigated in this study to allow for conclusive arguments regarding hominids' behavior and cognitive ability in lithic manufacture.

The table and figure below create a visual representation of the above patterns in the distribution of flake termination types. Table 5.3 shows the frequency of different flake termination types. Fig 5.12 compares different flake types across the study sites.

Termination Type	FxJj18IHS	%	FxJj23	%	FxJj20E	%	FxJj 50	%
Feather	150	55.15	69	78.4	153	73.91	171	82.61
Hinge	25	9.19	13	14.77	18	8.69	10	4.83
Broken	77	28.03	2	2.27	15	7.24	12	5.79
step	20	7.35	4	4.5	21	101.14	14	6.76
Total	272	100	88	100	207	100	207	100

Table.5.3. Frequency of different flake termination types across the key sites

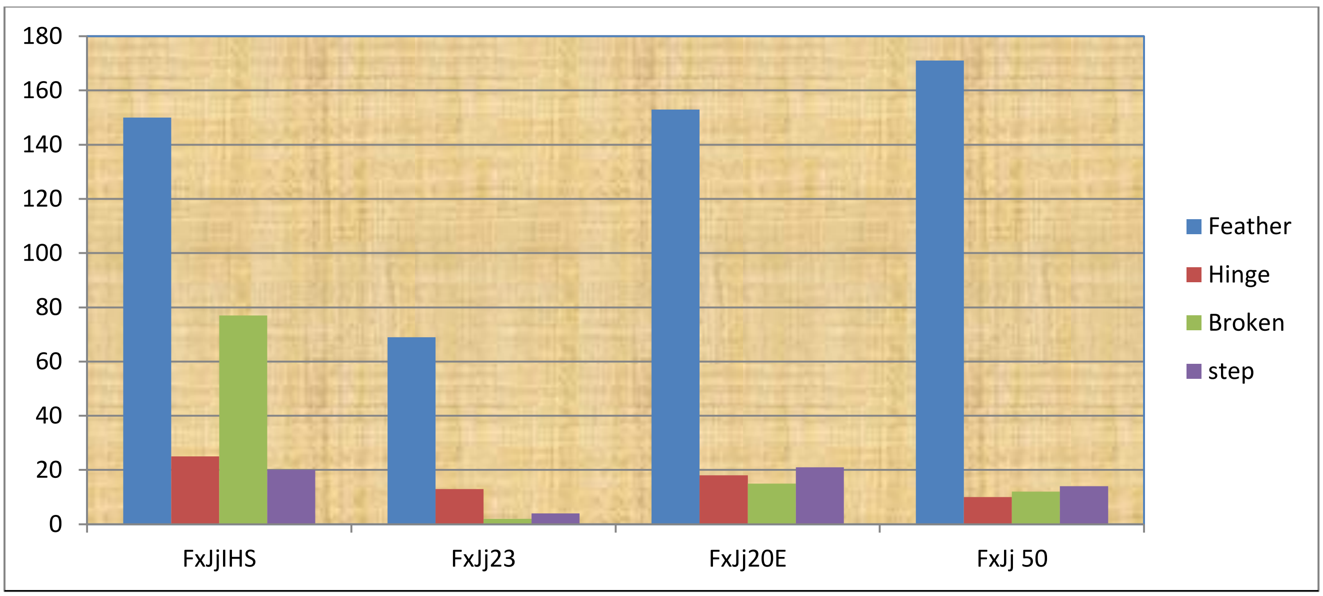


Fig.5.12. Graph showing the distribution of the four termination types across the study sites

5.7 Artifact types

Unlike the KBS member times, 2.0 Million years ago when hominids occupied areas along paleo-river channels hence concentrating artifacts along these areas, Stone artifacts from the Okote Member represent the lifeways of early hominids in diverse settings (Stern 1991).

Therefore, this analysis allows the Okote Member to be viewed in a manner that demonstrates the environmental and climatic selective pressures and uses that acted on a tool hence mediating their behaviors in diverse. Even though transport was common at the time, refitting studies, (Schick, 1987) have demonstrated that the flaked pieces were commonly transported from one locality to another. Therefore, these dynamics are likely to impact the overall character and composition of the assemblage.

With few modifications to Leakey's (1971) morphological and functionality typology, the artifact types encountered in this study reflect an expected pattern for all the sites. From the gathered results, there is a high proportion of detached pieces compared to cores and cobbles. The relatively low proportion of cobbles and cores may reflect lithic-related activities that hominids were involved in such as the "curation" of such pieces from one space to another on the paleo-landscape. This pattern has shown consistency between the assemblage proportion of the cores and cobbles from detached pieces by Harris (1978).

Harris (1978) noted that assemblages located in the flood plain context had more than 92% detached pieces and less than 7% cores and cobbles, a pattern that this study agrees with. However, from this study, cores and cobbles only represent 2% of the overall assemblage from the sites. Cores are conspicuously missing at FxJj50 with a 0% representation from the analyzed sample. This is quite surprising because it is the same site with the highest representation compared to other sites. At FxJj50, whole flakes account for 61.6% of the overall sample while angular fragments account for 27% of the analyzed sample. Whole flake figures at FxJj50 are closely followed by FxJj23 with 59.42% representation. FxJj20E takes third place with 37.76% followed by FxJj18IHS with a 37.37% representation of the whole flakes.

In comparing the frequency of angular fragments across the sites, FxJj20E takes a lead with 30.01% while FxJj18 HIS has the lowest values at 23.8%. FxJj20E sets its self apart from other sites given its high frequency of modified tools. It is the only site with the highest representation of modified tools including core and flake scrappers at 3.9% rivaling FxJj18IHS with 3.6%. FxJj50 and FxJj23 follow behind closely with only a 1% representation of the modified tools. It is worth noting that the high number of snapped and split flakes from FxJj18 IHS with 16.2% and 10.1% respectively is surprising.

Whole flakes represent 70% of all the assemblages from the four sites representing an expected pattern. However, the high proportion of whole flakes from FxJj50 compared to FxJj18 IHS is surprising. This might reflect the lithic-related activities that hominids were involved in on the Paleo-landscape at the site. Zero representation cores and cobbles at 50 might reflect transport activities that hominids were involved in from the site to other localities. In addition, this pattern might reflect hominids' ability to maximize the use of a cobble due to the scarcity of raw materials.

The high frequency of angular fragments from all the sites (more than 30%) means that these localities had undergone minimal disturbance through winnowing action either through erosion or moving water. Also, this offers spatial security for materials from FxJj23, a site that was reported to be highly disturbed by water currents. Even though the materials from the site have undergone size sorting, a minimal disturbance is expected and the materials might not have been moved for longer distances.

The high representation of cores and flake scrappers from site FxJj18 HIS compared to other sites demonstrates the significance of the site to hominid occupation during the Okote Member times. With a total of 27 modified pieces, the site rivals other sites including FxJj20 E and 50. Previous studies by Keeley& Toth (1991) demonstrated that these tools might have been used for scrapping wood and animal skins among other functions. It is through the availability of such tools at this site that tool assemblages from this time were classified as the Karari Industry, named after the recovery of these scrappers. Taken together, the results from the artifact type's analysis are crucial as they partly answer the question regarding the commonalities and variations of hominids' behavior across sites during the Okote member times.

The tables and graphs below create visual representations of the patterns in artifact types as described above. Table 5.4 shows the frequency of different artifact classes from the four sites. Figures 5.13- 5.17 shows the distribution of different artifact types across the four sites.

Table5.4. Frequency of distribution of different artifacts types across the study sites

Artifact Types	Sites FxJj23	FxJj20E	FxJj18IHS	FxJj50
Whole Flakes	82	142	154	191
Angular Frags	25	113	98	84
Snapped Flakes	3	30	67	11
Cores	8	7	7	0
Split Flakes	7	35	42	7
Snapped/Split	0	5	8	1
Cobble Frags	6	7	7	0
Core Frags	0	0	3	10
Unmodified cobbles	1	8	0	0
Core Scrappers	0	6	22	0
Flake Scrappers	1	9	5	4
Pebbles	0	13	12	0

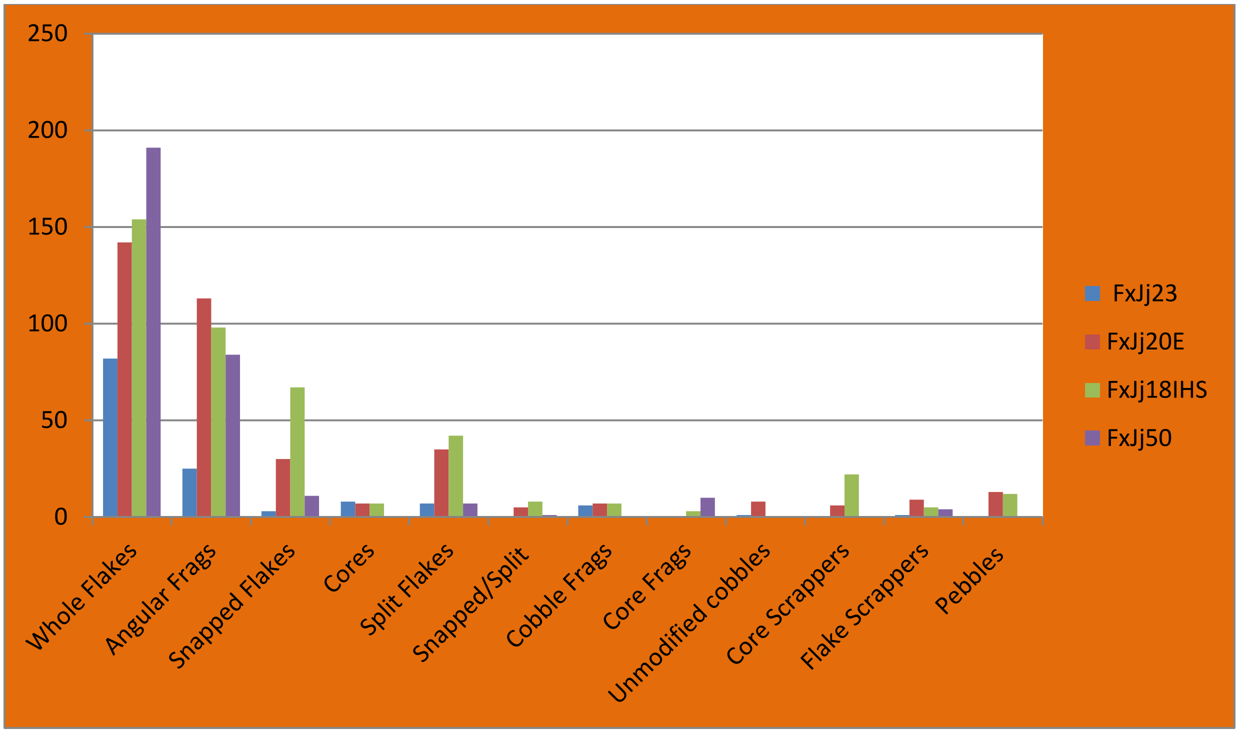


Fig5.13. Graph comparing the distribution of different artifact types across the four sites.

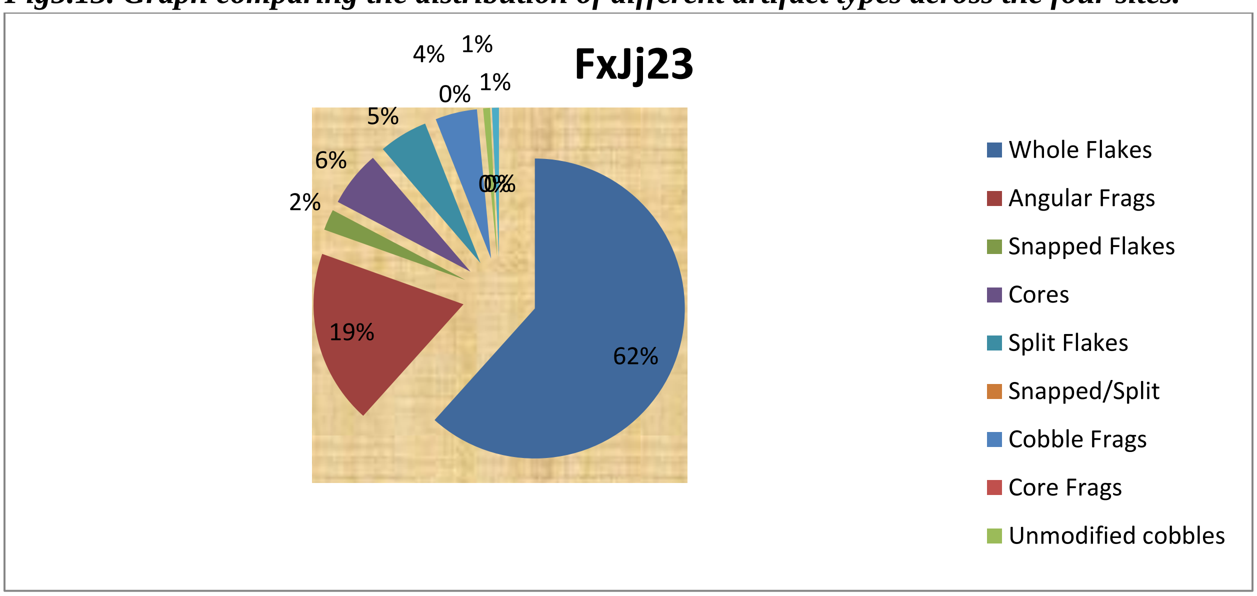


Fig5.14. Pie chart showing percentages of different artifact types at FxJi23

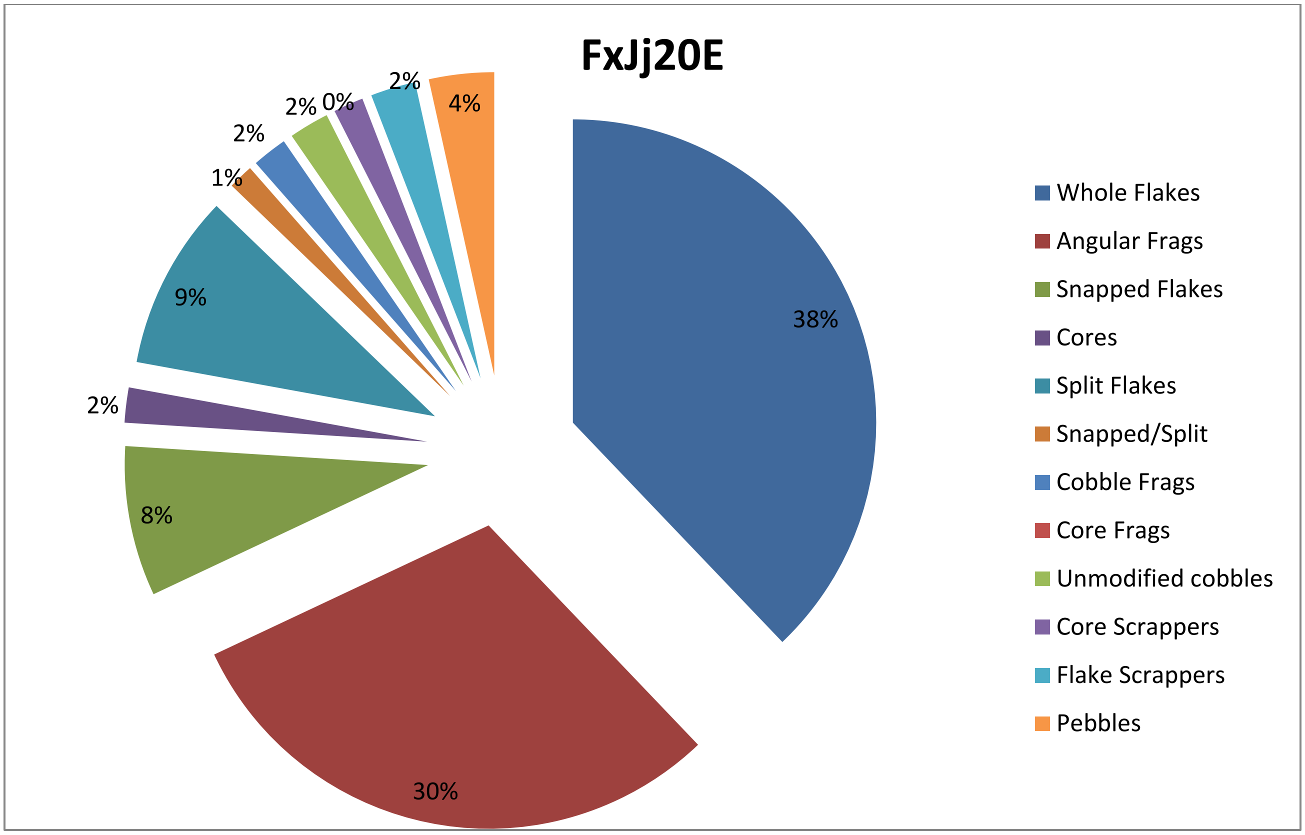


Fig5.15. Pie chart showing percentages of different artifacts classes at FxJj20 E

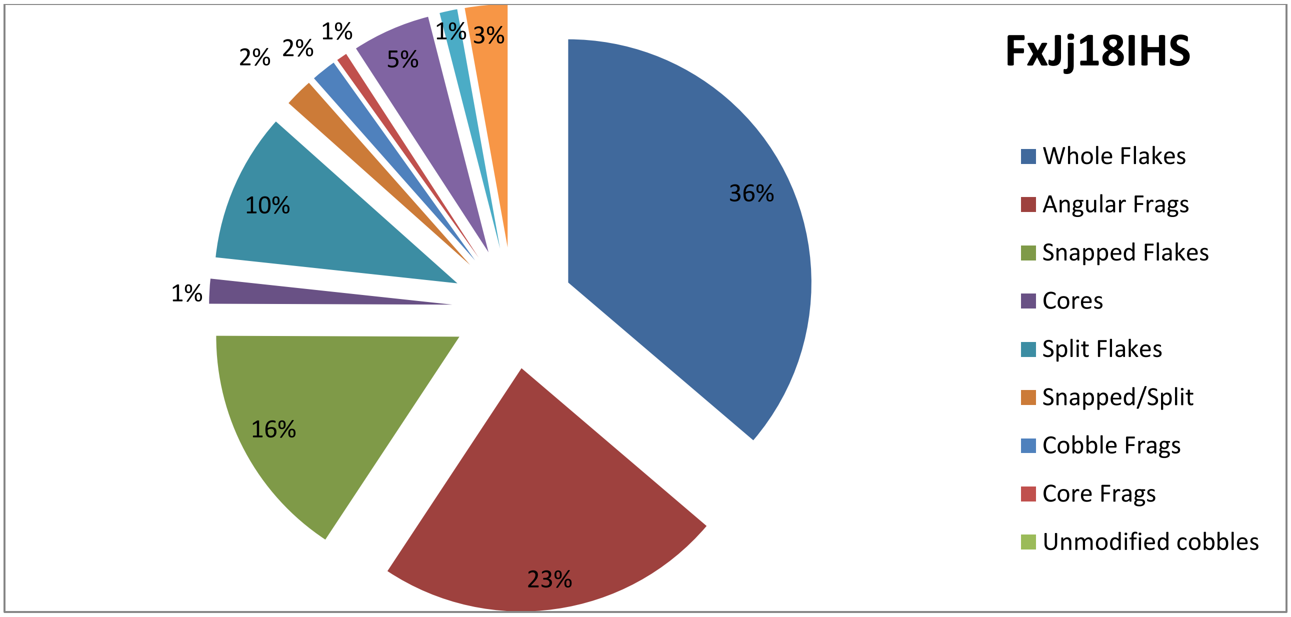


Fig.5.16. Pie Chart showing percentages of different artifacts types from site FxJj18 HIS

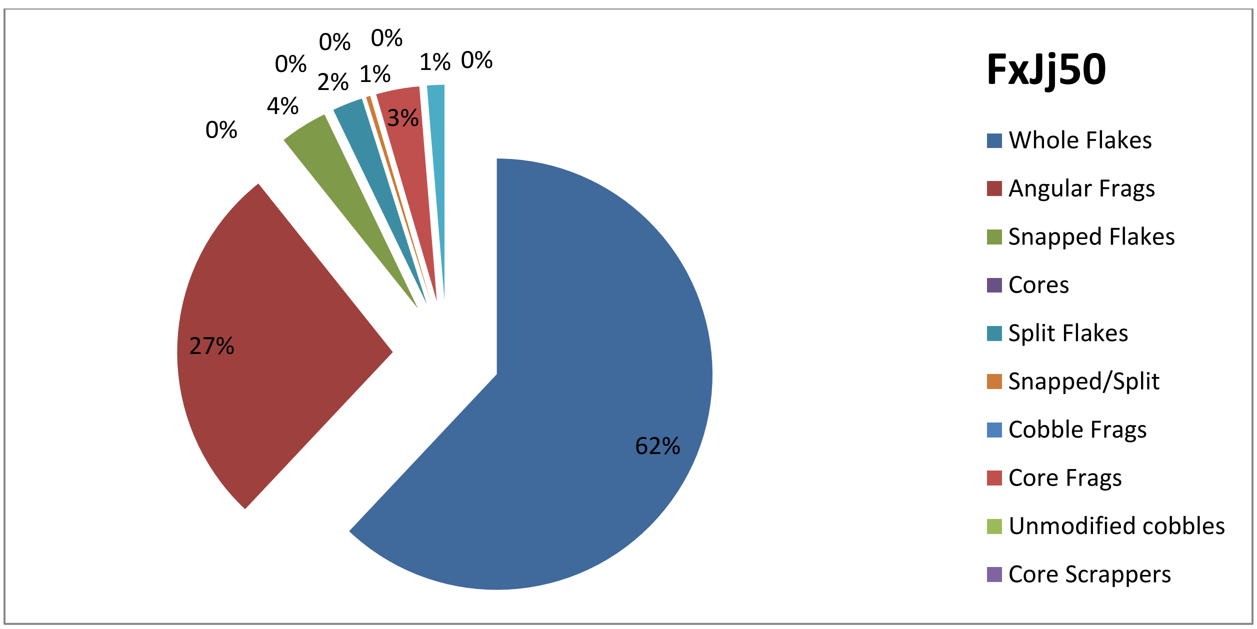


Fig.5.17. Pie chart showing percentages of different artifacts types from site FxJj50

5.8 Toth Types

Toth (1982) used the technological flake category system to interpret the models of tool production at several Plio-Pleistocene sites. This model has proven to be effective and has been widely applied in the study of many Plio-Pleistocene sites from many areas; for example West Turkana by Kibunjia (1994), Olduvai by Kimura (1999, 2000), and at Olorgesaille by Noll (2000).

Understanding Toth types from the sites are vital as it informs about the activities that took place at the site. On one hand, the dominance of flake types 1-3 at a site indicates that raw material was a critical resource at the time and was in close proximity which prompted settlement at that particular space by the early hominids. On the other hand, sites dominated by type 4-6 tools imply later stages of reduction which might have resulted from reworking ready tools or overworking on a cobble due to inadequacy of raw materials.

Below is a breakdown of six types of flakes according to Toth (1985) that will be used in this research.

1. Stage 1- Dorsal surface and the platform are fully cortical
2. Stage 2 - Dorsal surface is partly cortical with the platform fully cortical
3. Stage 3- Platform fully cortical and non-cortical dorsal surface
4. Stage 4- Dorsal surface is fully cortical and the platform non- cortical
5. Stage 5 - Dorsal surface partly cortical and platform non-cortical
6. Stage 6- Non -cortical dorsal and platform surfaces.

While the results from the study of Toth types (TT) from the key sites are unique, the high frequency of TTVI from all sites is quite interesting. However, the distributions of these different

Toth Types at FxJj50 do not follow this pattern. For instance, TT V and TT VI values at FxJj50 follow each other closely with 29.3% and 33.2% respectively. In contrast, the figures from FxJj18IHS, 20E, and 23 are skewed towards the TTVI values at 68.4%, 73.9 and 55.9% respectively. Across all four sites, TTI has the least figures with 1% representation at FxJj18 HIS and 5.35% for the FxJj50 site. Overall, the dominance of Toth Types 4-6 across all the sites and the less dominance of stages 1-3 across the sites revealed an unexpected pattern.

While it is difficult to offer explanations or the high number of TTVI flakes at FxJj18IHS, a possible explanation might be associated with the hominid behavior of transporting worked cobbles and reducing them at the site. Another reason might be attributed to the high rate of chemical weathering at the site which might have affected the physical appearance of the flakes, making it difficult to distinguish between cortical and non-cortical surfaces.

There are several other possible explanations for these patterns. For example, the high frequency of Toth Types VI at 20E might be attributed to the intensity of reduction that took place at the site. Harris (1978) noted that at this site, very small exhausted cores were recovered hence attributing the site to represent the final stage of the reduction sequence. As such, at FxJj20E hominids not only brought along with them fewer cortical cores to the site from other areas but also made smaller less cortical flakes. Equally, the dominance of type VI flakes at the same site might be attributed to the process of reworking bigger pieces through retouch or the process of making usable flakes. At FxJj18 IHS, the dominance of type VI flakes might be attributed to the process of reworking bigger pieces either to retouch them for use or to blunt them. From the analyzed sample, the site has the highest frequency of flake and core scrappers, all of which are manufactured by continually removing smaller flakes at the edges of these pieces.

The high frequency of type VI flakes at other sites including FxJj23 might be attributed to the fluvial activities the site had undergone hence winnowing away smaller types1-3 pieces from the site. In addition, since site FxJj23 is located at the closest distance from the raw material sources, it is conceivable that hominids transported artifacts from this site for use elsewhere on the paleo-landscape. Such activities, therefore, are very likely to deflate the original number of types I-III artifacts from the site. Unlike other sites with a very high frequency of types VI pieces, FxJj50 sets itself apart. The distribution of types I-VI types is not as skewed as seen from the other sites. In this regard, the site has the highest frequency of Types 1-3 pieces overall compared to other sites. Even though these results cannot be used to fully answer the question of hominid behavior in curating and transporting lithic across the landscape, partly, they give an insight into selective pressures that might have acted on the hominids hence mediating their behaviors.

5.9 Platform Types

Reconstruction of hominids' behavior and cognitive abilities cannot be complete without assessing their ability and skill to produce preferred sizes, and shapes of artifacts. In most cases, the type of exploited platform in lithic manufacture not only reflects the knapper's skills in tool making but also their cognitive ability to make huge flakes from small platforms. It is as a result of these dynamics that archaeological assemblages are characterized by the presence of myriad types of platforms. In this regard, this study assessed and recorded six types of platforms including broken, crushed, single-faceted, double-faceted, multifaceted, and point platforms.

Across all three sites, over 70% of the flakes from the sites have single-faceted platforms. For instance, both FxJj20 E and FxJj18 IHS take the lead with a 70.5% frequency of single-faceted platforms. FxJj23 follows behind closely with a frequency of 70% flakes. Fxj50 is the only site that deviates from the above pattern with only 55.9% of its artifacts made from single-faceted platforms. In comparing how crushed platform types are represented in the assemblages, the figures from FxJj50 stand out again with the highest figures of 30.3% with the lowest from FxJj18 IHS at 8.08%. FxJj23 and FxJj20E have 20% and 13.7% respectively see fig 5.5.

Other unexpected results from the platform type analysis include a 0% representation of broken and pointed platforms from FxJj23 and FxJj50. In addition, FxJj18 IHS has the highest figures for multifaceted platforms at 6.9% compared to 1% representation at other sites. Only a few of the recorded pieces have double-faceted platforms across the sites. FxJj18 double faceted platform values include 11.3%, FxJj20E at 9.8%%, FxJj23 at 8.9%, and 8.13% for FxJj50.

Understanding platform measurements is equally crucial in the reconstruction of hominid behavior. Platform length measurements have provided very unique results in this study. For example, the close values in platform length between sites FxJj20E and FxJj50 are very interesting. FxJj20E and 50 mean length values are 14.37mm and 14.29mm respectively. In addition, the two sites have the smallest platform mean length compared to FxJj23 at 21mm with the highest mean followed by FxJj18 with a mean of 17.07. While these results are quite unexpected, possible explanations can be offered especially for the huge platform mean for FxJj23. The site had an abundance of raw material for exploitation hence it was unnecessary to save up on the exploited platform used in making every piece. These results also help answer the research objective on the composition and character of lithic assemblages during the Okote Member times.

The table and figures below create a visual representation of the patterns in lithic manufacture as explained above. Table 5.5 shows the frequency pf distribution of different platform types across the four sites. Figures 5.18-5.22 shows percentages of different platform types across individual types apart from Fig. 5.18 which compares different platform types across all the sites.

	FxJj18IHS	%	FXjJ20E	%	FxJj23	%	FxJj50	%
Broken	8	2.9	0	0	2	0.85	0	0
Crushed	22	8.09	18	20	32	13.67	71	33.97
Single faceted	191	70.22	63	70	165	70.51	117	55.98
Double faceted	31	11.39	8	8.9	23	9.83	17	8.13
Multifaceted	19	6.9	1	1.11	5	2.14	4	1.91
Point	1	0.36	0	0	7	2.99	0	0
Total	272	100	90	100	234	100	209	100

Table 5.5. Frequency in the distribution of different platform types across the four sites under study

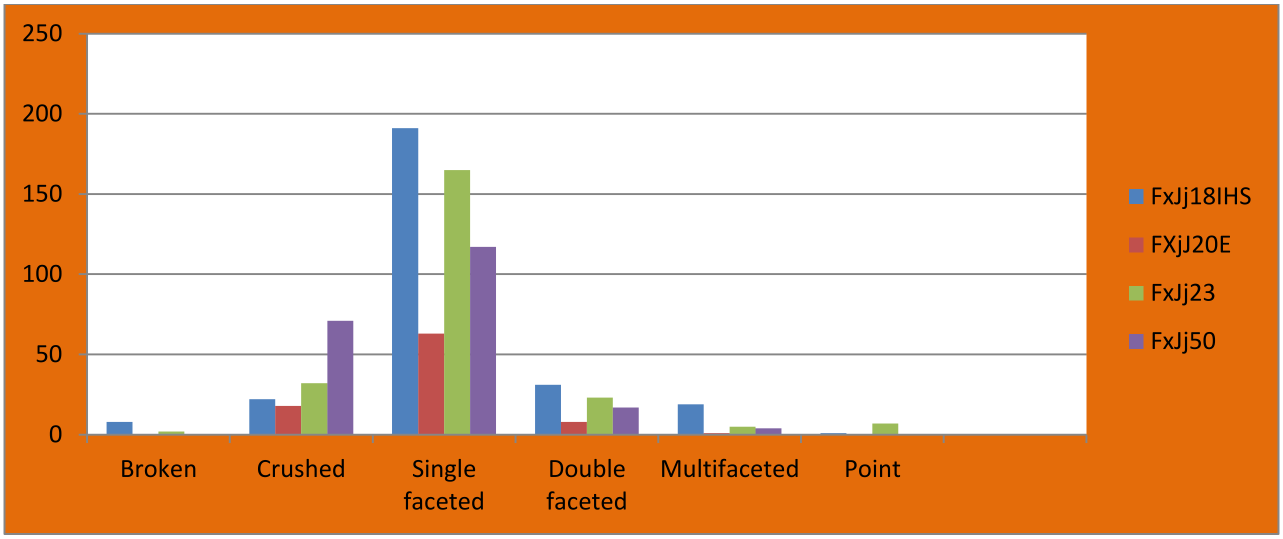


Fig.5.18. Graph comparing the frequency of distribution of different platform types across the study sites

5.10 Amount of Cortex

The degree of lithic transport on the paleo-landscape helps inform us about hominids' patterns in procurement, use, re-use, and finally discard of stone tools on the landscape. In most cases, these behaviors are influenced by several factors; availability of raw materials, water, and food. While this can be assessed using various parameters, assessing the amount of cortex in an assemblage is one of the ways through which these patterns can be investigated.

Assessment of the amount of cortex across sites has revealed unexpected results. Sites expected to have more cortical pieces in the assemblages due to their proximity to the raw material sources have lesser cortical pieces such as FxJj23 with a mean of 26.42. In contrast, FxJj50, located at the furthest distance from the raw material source, has the highest mean of cortex representation at 33.57 mean. In addition, the figures from FxJj20E were not expected. Harris (1978) argued that the site represented the final stage of lithic reduction; it is expected to have the least amount of cortex mean. However, the cortex means from FxJj20 E rivals that of FxJj18 IHS at 20.01 and

14.56 respectively. These results are crucial for the study as they partly help answer the question of hominid behavior and cognitive ability. Hominids had the ability to fore plan how and where to transport stone tools, a factor that was probably influenced by the availability of crucial resources on these landscapes. Table 5.5 and fig 5.23 creates a visual representation of the patterns that have been explained above

	FxJj18IHS	FxJj23	FxJj20	FxJj50
Amount of cortex mean	14.56	26.42	20.01	33.57

Table5.6. Frequency of distribution of amount of cortex mean across the four sites

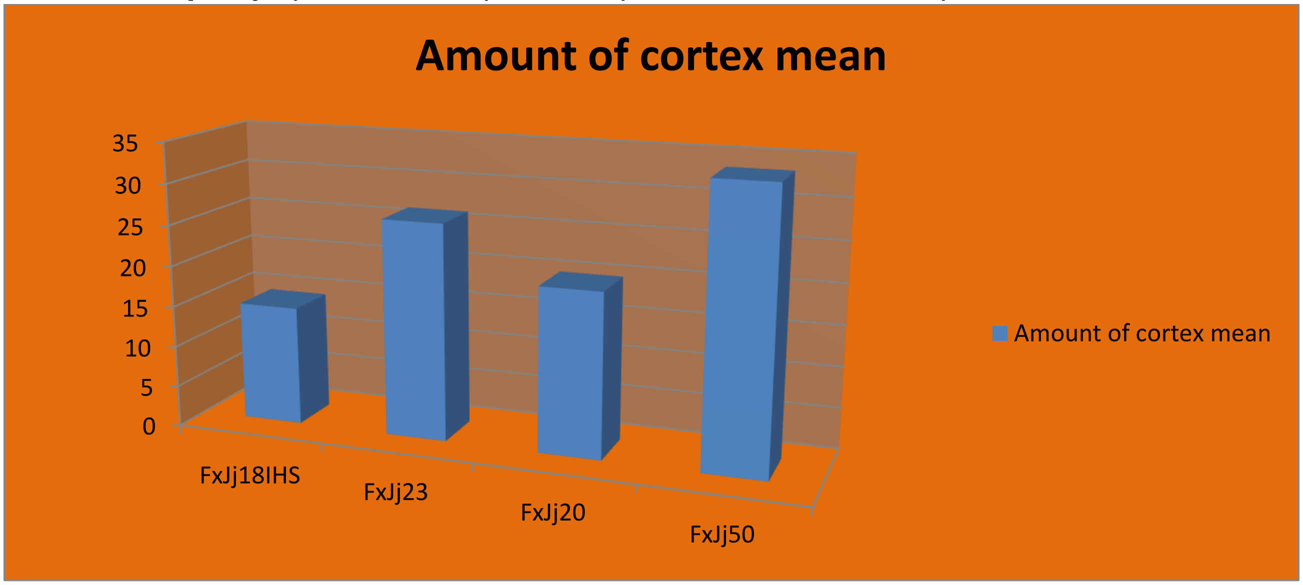


Fig.5.23. Graph comparing the distribution of the amount of cortex mean across the four sites under study.

5.11 Bulb of Percussion

Assessing bulbs of percussion types is very crucial as it shows hominid behavior in the choice of a certain lithic manufacture technique over another (hard hammer, soft hammer, and bi-polar percussion). While such decisions are highly influenced by the raw material available as well as the size of cobbles, at times, hominids' cognitive ability plays a vital role in the choice of a certain knapping technique over others.

Bulbs of percussion types were assessed on the lithic assemblage to reconstruct hominids' behaviors. All sites show a dominance of flat bulbs of percussion with FxJj50 taking a lead with 88.9% followed closely by FxJj23 at 63.51 %. In addition, FxJj18 HIS has close figures at 55.6% compared to FxJj20 which has the least representation of the flat bulbs of percussion at 48.8%. However, despite the few flat bulbs at FxJj20 E, it has taken a lead in the frequency of thick bulbs of percussion with 41.9% compared to FxJj23 with the least representation at 8.1%. FxJj18 HIS follows closely behind FxJj20E with 29.1 % thick bulbs as FxJj50 follows in third with 10.1%. Also, FxJj50 has the lowest representation of prominent bulbs at 1% compared to FxJj23 with the highest representation at 28.4%. FxJj 18IHS holds the second position followed by FxJj20E with the third-best frequency of prominent bulbs. Table 5.6 creates a visual representation of bulbs of percussion for these patterns across the sites, while figure 5.24 compares different bulb types across the sites.

Bulb of percussion	FxJj50	%	FxJj23	%	FxJj18IHS	%	FxJj20E	%
Flat	176	88.9	47	63.51	151	57.85	105	33.33
Prominent	2	1.0	21	28.37	34	13.02	20	6.34
Thick	20	10.1	6	8.1	76	29.11	90	28.57
Total	198	100	74	100	261	100	315	100

Table5.7. Frequency of distribution of different bulbs of percussions across sites

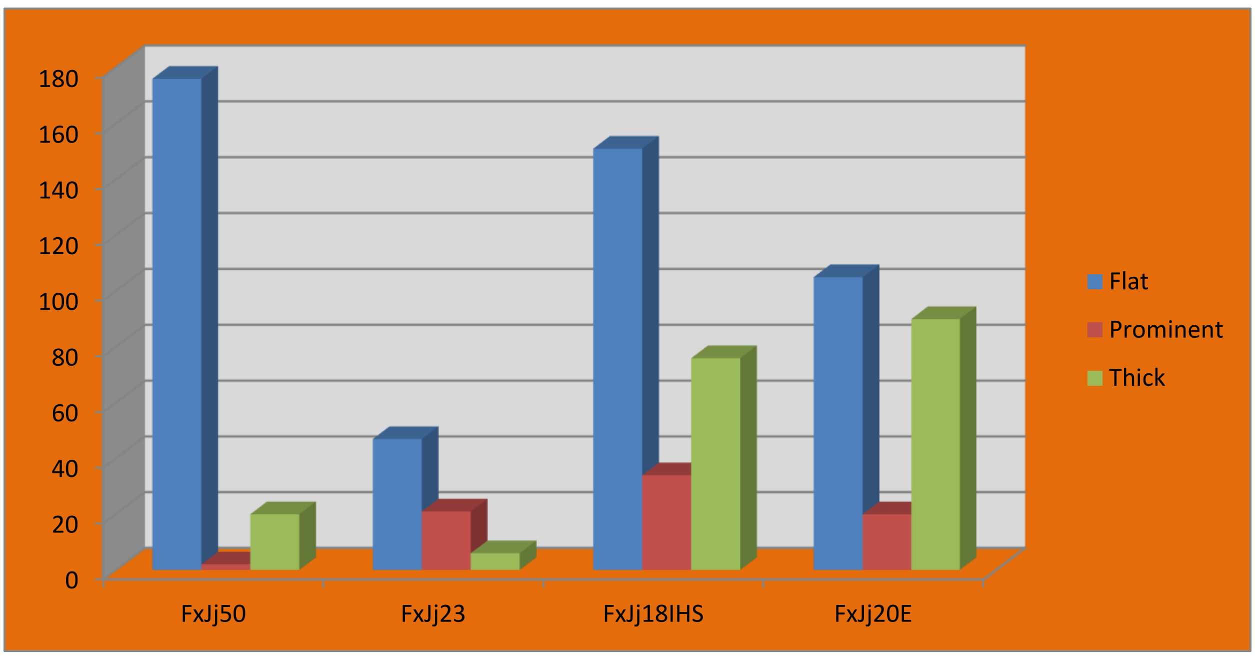


Fig5.23. Graph comparing the distribution of different bulbs of percussions across the four sites

5.12 Conclusion

From the foregoing chapter, the results help answer the three main questions of the study. Various results highlighted from different attributes including; raw material types, amount of cortex, artifacts types, and tool types, clearly show significant variations and commonalities in the assemblages from the key sites under study. Therefore, taken together, the results presented above answer the questions under study in different ways. Some address issues on commonalities and variations while others depicted patterned ways of hominids' behaviors and cognitive abilities, aspects that will be explored in detail in the next chapter (See conclusion and recommendations chapter). They also provide an opportunity to assess the results holistically by comparing how various site results vary and what this would mean regarding hominids' behavior on a wider landscape scale.

CHAPTER SIX

DISCUSSION

6.1 Introduction

This chapter makes a detailed explanation of the data presented in the previous chapter. It correlates the data presented and its significance making inferences about what it implies in regard to hominids' behavior and settlement patterns. The central place and the resource availability theories used in the study were able to show how various variables in the study interacted and how they affected the character, density, and composition of artifacts at archaeological assemblages from the key study sites hence mediating hominids' behaviors.

In this study, lithic analysis was viewed as a part of a long procedure involving empirical observations of the stone artifacts, making low-level inferences from the attributes observed, and finally interpreting the inferences made with higher goals towards understanding the lifeway and behavior of early hominids as well as their capabilities. For example, analysis of attributes such as the amount of cortex, raw material type, platform type, tool type, artifact size, flake type, bulb of percussion, and Toth type, may enable one to infer the reduction stages of artifacts present at one archaeological locality. Therefore, inferences were made regarding hominid settlement patterns and life ways during the Pleistocene period. This was done by delineating different patterns they were involved in including, procurement of resources, distances traveled to procure these critical resources, manufacture, use, and discard patterns involved, and the location of "home bases" on the paleo-landscape.

6.2 Raw materials

The primary raw material selected by the early hominids has a powerful force on the overall nature of the archaeological assemblages. This is because raw material characteristics highly limit the archaeological signature of human behavior. Studies of economies involved in raw material procurement have revealed that the variability of raw materials impacts archaeological patterns in numerous ways (Toth, 1982). For instance, the diversity of raw material procurement strategies documented throughout Early Stone Age archaeological assemblages highlights the geographic variability and adaptability of early hominids. Also, it leads to the question of whether some raw materials were being used preferentially over others for different purposes.

One way the usage of different raw materials can be identified in the archaeological record is through the morphological analysis of cut-marked fossils (de Juana et al., 2010). The physical and structural characteristics of different stone raw material types, such as elasticity, hardness, and brittleness, can create tools with unique cutting-edge shapes (Eren et al., 2014; Goldman Neuman and Hovers, 2011). It has also been reported that certain Oldowan tools were knapped differently depending on the raw material they are made from, which would also lead to tool forms having distinct cutting edges (Gurtov and Eren, 2014). Comparatively, analyses of Acheulean tools revealed that hand-axes created from different raw materials tend to vary in both morphology and size. Such might be the factors behind significant variations in artifact types, morphology, and raw material types in the assemblages.

Within the Lake Turkana basin, most of the stones come from the eastern areas and range from medium to –fine-grained volcanic basalt (Braun 2006) and trachyte (Toth 1982). Other raw materials explored at the site included phonolite, Chalcedony, chert, Ignimbrite, and quartz. However, cryptocrystalline silica such as chert, chalcedony, and quartz are very rare. Harris

(1978) argued that there are several unknown sources of chert five kilometers from the volcanic hills in area 130.

From this study, while it is conceivable that some of the raw materials were sourced from the primary source (Surgei Cuesta), especially for FxJj23, it is undeniable that the majority of stone tools were made from river-worn cobbles found in the gravels of the ephemeral streams that drained into the basin. However, the pattern of raw material procurement for three other sites might have been a different one from that of FxJj23. For instance, at FxJj50, cobbles might have been transported for very long distances and stored for future use, an argument Schick (1982) proposed. In addition, Schick's argument was seconded by Lepre (2009) when he argued that cobbles within the conglomerates around FxJj50 were too small (less than 9 m) to account for the overall artifact assemblage at the site. Therefore, compared to other sites, FxJj50 represents unique foci of activities in a particular space in regard to raw material procurement strategies employed.

Overall, the pattern reflected here shows basalt dominance on the landscape might have contributed to its prevalence in the archaeological assemblage across the sites. Even though it was not as high as 100%, the proportion of basalt across the four sites was 98% apart from FxJj50. Following basalt dominance in the assemblages, we can infer that at this particular time, hominids were not preferentially selecting certain raw materials over others. In addition, the high frequency of basalt raw material could mean that early hominids preferred using the readily available raw material at the expense of the rarer types. In addition, the dominance of basalt raw material at FxJj50, the site located about 20 km away from the raw material source, implies hominids' cognitive ability and knowledge of networks where they transported unworked cobbles to the site for future use. An argument reinforced by Schick (1982) where she referred to FxJj50 as a preferred location on the landscape during the Okote Member times, Toth 1980 in his refitting studies, and Lepre (2009) when he argued that the paleo-streams transported very small pebbles(less than 9mm) which were not suitable for tool manufacture. However, even though basalt was the most procured raw material, other raw material types were also procured such as chalcedony, chert, ignimbrite, quartz, and phonolite. This could mean that early hominids, appreciated the benefits associated with using such materials including their durability, flakability, and sharpness.

The relatively high incidence of cryptocrystalline silica materials at FxJj50 could be interpreted in several ways. Hominids' cognitive ability to discern benefits ripped from exploiting cryptocrystalline raw materials such as; the ability to produce sharper, durable edges and flakability hence exploitation of more exotic raw materials on the landscape. Another possible explanation would be the one proposed by Harris (1978). He argued that in area 130, exotic raw materials were located five kilometers from the volcanic hills from the sites. The proximity of these raw material types to the site as well as the bundles of benefits associated with them led to high procurement and use by early hominids.

Further, the study site embodies hominids' behavior in different micro-geographical settings with sparsely distributed resources. For example, at FxJj50, hominids at the site were involved in very diverse activities compared to their counterparts. For instance, the exploitation of exotic raw materials resources at 50 coincides with the greater abundance of cut-marked bones at the site. This further informs more about the preferential selection of exotic raw materials such as chert, chalcedony, and ignimbrite. This choice of exotic raw materials demonstrated hominids' appreciation of the best raw materials types performing butchery tasks, something exotic raw materials such as quartz and cherts do better compared to the very abundant basalt raw materials.

Schick and Toth , (1993) study revealed that in butchering activity, quartz flakes were considered more efficient than basalt flakes. Hominids' cognitive ability allowed them to discern that tools made from exotic raw materials were not only easier in terms of their flakabilitty, durability, and ability to retain very sharp edges. A different study conducted at BK in Olduvai George by Yravedra et al 2017b supported a similar argument that raw material selectivity was key in performing butchery tasks. From his study, flakes made of granular quartz were preferentially used at the site compared to flakes made from other raw material types; this is because, during butchering activities, the quartz flakes made chisel-like edges suitable for butchering that was also very durable.

Overall, the study has demonstrated that raw material availability and suitability were pivotal to hominids' diverse activities. It not only demonstrated the dynamics involved with the procurement, transport, use, re-use, and discard on the paleo-landscapes but also emphasizes its critical relevance in the placement of location spaces on these landscapes. However, raw material alone was not the only defining factor in settlement patterns of early hominids, availability of other resources was also critical such that they settled at a site 20km away from raw material sources owing to its significance in terms of water and faunal abundance. In such spaces, “curation” from sites closer to raw material sources became the dominant practice.

Further, procurement or diverse raw material types was not only determined by their availability but also by the planned use of the tools made from certain raw materials over others. Basalt was widely used in all sites due to its abundance; exotic raw materials including chert and ignimbrite were widely used at FxJj50 due to its abundance or due to their significance in butchery activities.

6.3 Flake Types

Flake-type results from the study show the dominance of primary flakes at some sites (those at the furthest distance from the raw material sources) compared to others. This pattern depicts hominids' behavior in curating materials, usable flakes, no-cortical cores, or unworked cobbles on the landscape for use elsewhere. This requires a lot of planning and premeditation whereby, they were aware of which spaces on the landscape, the curated pieces would be used, a factor aided by their cognitive ability.

The dominance of primary flakes at FxJj50 coincides with the high cortex mean at the same site. Two possible explanations might be given to explain flake-type results from the site. Schick (1982) argued that this was a preferred location where hominids frequented the paleo-landscape, which meant that unworked cobbles were transported for future use. The river channels that flowed close to this site provided not only water but also diverse food resources that hominids procured, as such, she argued that hominids transported unworked cobbles to this site in readiness for future use. Such arguments have been reinforced by Toth (1982) in his refit studies where he argued that it was the only site where he was able to refit most of the stones from the archaeological assemblage. Bunn (1980) also shared similar arguments and argued that it was the site with the best preserved and the highest frequency of cut-marked bones. These arguments as well as the results from this study reflect the complexity of activities hominids were involved in at the sites including lithic manufacture and butchery.

Differences in flake types as revealed from the study demonstrate hominids' procurement practices from one site to another owing to the abundance or scarcity of these critical resources. Overall, these practices affected the overall composition and character of archaeological assemblages.

6.4 Reduction sequence

It is considerable that early hominids were doing different things on different micro-habitats. However, previous studies by Toth (1982) have demonstrated that artifacts from sites represent interrelated dynamic activities of the entire space. This is well echoed in Isaac's stone flow theory. Contrary to this argument, other studies have demonstrated that sites represent unique foci of activities (Reeves, 2019). The dynamic processes involved in stone procurement, reduction, transport, use, and finally discard of the final product is a complex of the entire whole. Hence, it is expected that depending on different spaces on the landscape, sites preserved different stages of stone reduction sequences. In support of this, Isaac's (1986) stone flow model suggested that archaeological sites close to the raw material source tend to preserve larger flakes and cores. In addition, such sites and lithic assemblages have greater proportions depicting early stages of reductions with a high amount of cortex compared to those located away from the raw material sources.

In the study, different reduction stages were reported from the sites. The small light flakes from FxJj50 with a mean weight of 5.5g and 21.32mm mean length reflects the smallest figures across all the sites. While this might imply that the site was in the last stage in the reduction sequence, an argument reinforced by the lack of cores at the site, it might also depict hominids' know-how and expertise in lithic procurement and production where they carefully and systematically targeted small flakes.

Also, the small-sized flakes might have been a result of shaping sequences during the lithic manufacture process. This argument of producing small flakes for a particular function has been reinforced by (Toth 1981) through his refitting studies at FxJj50. His studies revealed that almost everything produced from the site was eventually used there. In contrast FxJj23, the site closest to the raw material source, hominids were producing very huge flakes with a mean weight of 55.30g and length of 53.60, the highest across all the sites. FxJj23 would be considered the first stage in the reduction sequence. This might have resulted from the functionality involved with using huge flakes; or an abundance of raw materials that provided huge blacks for exploitation. Also, the proximity of the site to the raw material source allowed them repeated visits to the source to get more raw materials owing to its short distance. This a practice that was not possible for FxJj50 due to its long distance from the material source. Similarly, a site located further south of the Karari Escarpment, Gaji 5 revealed similar patterns of hominids' ability and knowledge networks given the highest number of cut-marked bones from the site with no single stone tool in association (Bunn, 1982).

In addition, the higher frequency of whole flakes at FxJj50 compared to other sites might be attributed to several factors including; the need to use these tools in different activities such as animal butchering. The presence of many cut-marked bones at FxJj50 and the lack of them in other key sites confirms the diversity of activities that move in different micro-habits as shown (Bunn, 1982). Also, pounded tools at FxJj20 E, one of the sites with the earliest evidence of palm trees and fire highlights the great significance of the site to hominids' occupation at the time and the diversity of intra-site activities involved.

Interestingly, from all the sites including FxJj23, the closest site to the raw material source, only 3% of all the flakes studied fall within the initial stages of reduction. More than 85% of the flakes from all the sites do not exhibit any cortical surfaces. Such an observation would lead to a conclusion that hominids were bringing in prepared cores with them to these sites in anticipation of future use. Such activities ensured profitability and predictability in the acquisition of carcasses of very large animals, a pattern that Sanchez Yustos et al. (2012) reported in their study.

Further, the lack of cortical flakes from all the sites depicts hominids' cognitive ability in carefully knapping cores at the source to reduce transport burden as well as increase the size of the cobble to be transported. However, this argument cannot be devoid of another possible explanation. It is likely that hominids were preferentially selecting cortical flakes or cores from the site of manufacture and using them elsewhere. However, the case at FxJj50 disagrees with this argument since refitting studies (Toth, 1980) demonstrated that almost everything that was made there was left there.

6.5 Knapping Techniques

Site patterning based on variations and commonalities has further been demonstrated through Knapping techniques used. In most cases, a site represents more than just a single knapping activity, with an accumulation of many visitations and knapping by different individuals over hundreds or thousands of years. Despite this contention, it is clear that these different percussion techniques were used interchangeably at the site probably to meet different functions.

It is evident that, in these different spaces on the paleo-landscape, hominids were involved with different tasks that necessitated diverse manufacture of tools through different manufacturing techniques. For example, across the sites, hard hammer percussion techniques were widely used in lithic manufacture. The differential bulb types attest to these differences in knapping techniques. The presence of thick and prominent bulbs at the sites reflects hominids' behavior in carefully and interchangeably executing different knapping activities using different percussion types.

In addition, differential representations of bulb types, termination types, and flake types can inform about the diversity and commonality of hominids' behaviors at different sites. For instance, soft hammer percussion dominates the assemblages across the sites. This is depicted by the high frequency of flat bulbs, feather terminations, and fewer broken flakes across all sites. Such a case is highly represented at FxJj50. Therefore, the high frequency of small flakes at FxJj50 coincides with the high frequency of the soft hammer percussion technique used at the site. FxJj50 takes the lead with the highest frequency of flat bulbs compared to other sites. This can be associated with hominids' selectivity on which technique to use rather than the reduction sequence stage represented by the site. This reinforces the idea that hominids were carefully making small flakes to meet different needs as opposed to the argument that this was the last stage in the reduction sequence line.

Moreover, the dominance of flakes with thick and prominent bulbs at FxJj18 IHS coincides with the high number of core and karari scrappers at the site. It is as a result of the dominance of these core and flake scrapers at the site that the term Karari Industry was coined, named after the Karari scrappers. This high frequency of these types of bulbs at the sites demonstrates hominids' cognitive ability which allowed them to employ hard hammer percussion. At the site, the hard hammer technique was suitable for producing huge flakes and splitting cores for later shaping, which eventually left thick and prominent bulb imprints on them. In addition, the hard-hammer technique used at the site depicted by the bulbs is further reinforced by the high frequency of broken flakes at the site. (Ludwig, 1992) argued that during the hard hammer percussion technique, broken flakes tend to be more than in the soft hammer percussion. The site beats all other three sites, through its highest frequency of broken pieces as well as the highest number of hinged and step fractures all add to this information.

6.6 Weathering stages

Weathering represents the post-use history of any artifact undergone since discard. Since weathering processes are only lumped into one artifact and operate on a very local scale, it becomes difficult to assess the degree of pre-burial time that the assemblage might represent. Hence an excavated weathered artifact might represent a series of exposures and re-burials, post-depositional processes as well as pre-burial surface exposure. Here, weathering has been used as an indicator of the lack of certain processes that might have affected the assemblage in one way or another.

While it has been observed that basalt weathering stages cannot be used to estimate the degree of time an artifact might have been exposed on the surface, Stren 1991, estimated that artifacts in fresh conditions would indicate they might have been on the surface for not more than 15 years. In addition, she noted that artifacts within weathering stages 4 and 5 would have been buried for not more than 10,000 years. This however does not address the issue of chemical weathering that might also affect the physical appearance of the assemblage. For example, despite having been recovered on a flood plain context, materials from FxJj18 IHS were highly weathered; almost 60% of the artifacts were classed as WS 4 and 19 % as WS4 with one that was classified as WS1. However, the rate of weathering especially on basalt raw material remains an unknown variable because it may vary across spaces, as well as the relative wind and rainfall, conditions, degree of seasonality as well a presence of different biological agents that might have acted on the surfaces of the stone assemblages.

Further, the study sheds light on a long outstanding debate about the site integrity of FxJj23. The re-analysis of the assemblage from the site revealed that different from the previous reports by Harris (1978) the site is located in a high-energy flowing channel; the fresh nature of the artifacts contradicts this argument. For instance, the relatively fresh nature of artifacts from FxJj23 is very surprising when compared to those from FxJj18 IHS. This is because; the assemblage at FxJj23 was deposited in a channel setting while the assemblage at FxJj18 was deposited in a floodplain setting that is characterized by less disturbance. One possible explanation for these results is that there are other factors acting on the assemblage. Factors such as; chemical weathering might have accelerated the rate of weathering of the assemblage at FxJj18 IHS. However, the high weathering rate at FxJj18 HIS remains an issue to be investigated in detail, despite being located at a flood plain setting. Another possible explanation of the results from FxJj23 would be, despite deposition in a channel setting and size sorting has been reported at the site, it is possible that the artifacts at FxJj23 were not transported for longer distances and that they had been covered quickly after fluvial transport.

6.7 Conclusion

The significant variations and commonalities reported from the study that greatly affected the composition, character and density observed in the archaeological assemblages reflect the selective pressures our ancestors encountered that mediated their behaviors. For instance, the diversity of raw material procurement strategies highlights the geographic variability and adaptability of early hominids. Therefore, their knowledge of procurement networks conditioned their location of sites at the furthest distances from the raw material sources owing to sites' significance in the availability of other crucial resources including food. Further, variations from the four sites depict their more developed knowledge and network that enabled our ancestors to have a more structured way of exploiting these diverse landscapes. Hence, the use of diverse raw materials types synergizes with; the familiarity with the properties and distribution of high-quality raw materials, and the greater precision in the control of the knapping sequences involved. Overall, it is evident that the availability of critical resources dictated the overall character, composition, and density of the archaeological assemblage.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This chapter draws attention to the main findings of the study. The other main component of this section is to determine whether the objectives of the study have been met and what inferences can be made about such patterns on a wider landscape scale. The research was based on three objectives. The first objective involved the reconstruction of hominid behavior in the procurement and use of exotic raw materials. The second aim was to examine the commonalities and variation of hominid settlement patterns relative to resource availability and finally, to compare patterns of behavior of early hominids across sites and on a wider landscape scale. The results derived from this study shed light on all of the issues investigated in the study. It has also allowed for inferences to be made regarding hominid settlement patterns, behaviors, and cognitive abilities.

7.2 General overview of the problem

Due to their ubiquity and durability, at many African sites, Early Stone- Age stone artifacts have been widely used in the study of early hominid behavior, lifeways, and capabilities. However, studies into early hominid settlement patterns and behavior in the Pleistocene periods, using inter assemblages comparisons remain scarce. A gap, this study aimed at filing.

The Turkana Basin setting offers a perfect opportunity to interrogate and reconstruct hominid behavior and settlement patterns. Some of these fascinating areas include the Karari Escarpment, an area endowed with very unique sites yielding hundreds and thousands of not only stone tools but also faunal and hominid remains. It is in these areas that the earliest evidence of control and use of fire as well as the pounding of nuts by hominids were recovered.

In addition at one of the sites, remains of Australopithecines mandible and Homo erectus stone tools were recovered at the same stratigraphic level. This led researchers to conclude that these three different hominids co-existed in the same environment before the extinction of the earlier species (Wood 1991). As a result of this association, it has continuously become difficult to ascertain who the makers of the Karari industry were. However, speculations have been made tying the question to Homo erectus, judging from the sophistication of the recovered tools from these contexts. Whether the stone tool assemblages represent the activities of all the hominids intertwined or if they represent a specific activity at a time in space of one hominid species remains an issue that is difficult to quantify and assess. This research aimed at investigating and comparing different sites and assemblages to ascertain, commonalities and variations of hominid behaviors exist, in different spaces on the paleo-landscapes from the stone tool signatures they left behind.

In this study, lithic analysis was viewed as part of a long procedure involving empirical observations of the stone artifacts, making low-level inferences from the attributes observed, and finally interpreting the inferences made with higher goals toward understanding the lifeways and behavior of early hominids and their capabilities.

For instance, analysis of stone tools attributes such as the amount of cortex, raw material type, platform type, tool type, artifact size, flake type, bulb of percussion, and Toth type, allows one to infer the reduction stages of stones at an archaeological site. Such inferences, along with the available knowledge of cobble sizes, raw material sources, artifact density, and paleo-ecological landscape setting can provide information about the transport of stone across the landscape. However, to achieve this, one must have a good working hypothesis as well as a representative sample of the artifacts from each site and each time interval, something this study adhered to. Inferences into hominid behavior and settlement patterns were made on several attributes as presented in the previous discussion chapter.

7.3 Summary

Recent paleo-climatic records reported by Blumenthal et..al (2011) have emphasized the significance of seasonal fluctuations that had significant amplitude throughout the Pleistocene period in East Africa. Such fluctuations resulted in many dynamic outcomes both on the plant biomass and low above-ground water for angulates. As a result, the low-fat angulates were the most affected both physically and psychologically (Sinclair 1975), a factor that might have led to their complete depletion from the paleo-landscapes at the time of hominids' evolution. These are just examples of pressures that early hominids had to endure. As such; different mechanisms were created to survive in the harsh environment at the time. Therefore, tool classes varied significantly depending on the availability of different sparsely distributed resources including (water, food, raw materials, and security) on the landscape.

In addition, the procurement strategies involved to access these resources varied significantly from those used in procuring. The pitted chert flake, as well as several pounding tools that have been used as cores from FxJj20E demonstrates the pressures emanating from raw material availability that the early hominids endured to a point of turning the hammer stone around and using it as a core. Also, the dominance of exotic flakes at FxJj50 tells the story of the need for efficiency in butchering different animals at the time, a vital resource needed by these hominids to feed their big growing brain at the time.

The study thoroughly addresses all the objectives of the study. Procurement and use of exotic raw materials have been well demonstrated from all the sites with a conclusion that hominids carefully selected different raw materials types based on their functionality, usability, and availability. This argument is reinforced by the dominance of exotic flakes at FxJj50 as well as the dominance of basalt raw materials from all the sites irrespective of the involved distances.

In addition, the study has vividly demonstrated variations and commonalities across the sites both in the raw material selectivity, and reduction sequences as well as in the transport of lithic tools on the landscape. One pattern that emerged from this objective is that hominids carefully transported cobbles to sites further away from the raw material sources, at one site while at others they used cores to the point of exhaustion. Reduction techniques were used interchangeably across the sites and the study has demonstrated that site functions defined the dominant technique to be used. For example, at FxJj50, a soft hammer technique was best suited for producing small flakes while at 18 IHS, hard hammer percussion not only produced huge flakes but also allowed the split of cores which were later transformed into core scrappers.

Site variations and commonalities have been demonstrated through weathering stages; FxJj18 has very weathered pieces compared to FxJj23, the only site under study located in a channel setting. In assessing hominids' behavior and lifeways, the study has vividly painted a picture of hominid behavior in a different micro-geographic setting that might have mediated their behavior as depicted in the lithic assemblages from all the sites. These different life-ways included procuring raw materials to pound nuts at 20, making tools for butchering animals and making huge tools either for transport at 23 or for use there as well as making scrappers for use at woodwork or other functions at 18 HIS. Keely and Toth (1981) once noted that within some of the scrappers recovered from the FxJj18 site was a pen knife suitable for woodworking or scrapping. It is this combination of factors including the location of the vital resources that mediated hominids' behaviors and lifeways, an issue that this study has fully addressed.

It is undeniable that armed with advanced cognitive abilities that allowed mastery and knowledge of their landscapes and networks, Homo erects were able to move out of Africa; 1 million years ago and populate other continents.

7.4 Recommendation

The study is vital as it involved an investigation of an issue that has always been overlooked before. Commonalities and variations of assemblages at a site level studies remain scarce from studies that primarily focus on variations at a wider geographical scale. While this study is very informative, the back slope (where one of the sites FxJj23) is located remains an area that is poorly investigated. More needs to be done in the area to unravel patterns of activities and behaviors that might have unfolded during the early Pleistocene times and to provide a holistic picture of these patterns. In addition, the study focused on a single site in the FxJj18 IHS and FxJj 20 complexes, the complexes need to be investigated in detail. The presence of four archaeological horizons on the same sites is quite interesting and remains an issue that is poorly studied. Several factors might have prompted hominids to occupy these sites and not elsewhere on the same landscape. What were the factors responsible for such an occupation? Therefore future research should look into these unexplored issues.

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Appendix

AMOUNT OF CORTEX

	Fxjj23	fxjj18ihs	fxjj50	fxjj20e
N	134	427	286	333
Min	0	0	0	0
Max	100	100	100	100
Sum	3540.93	6217	9600	6635
Mean	26.42485	14.55972	33.56643	19.92492
Std. error	2.871244	1.250021	2.129307	1.610003
Variance	1104.702	667.2095	1296.71	863.1721
Stand. dev	33.23705	25.8304	36.00985	29.37979
Median	0	0	20	0
25 prcntil	0	0	0	0
75 prcntil	60	20	60	30
Skewness	0.8591935	1.756906	0.6060596	1.328691
Kurtosis	-0.7519475	1.947111	-1.165349	0.4188605
Geom. mean	0	0	0	0
Coeff. var	125.7795	177.41	107.2794	147.4524

Length measurements

	FXJJ18	FXJJ23	Fxjj20e	Fxjj50
	A	B	374	310
N	439	66	0	5.84
Min	2.57	11.74	3035	68.92
Max	88	203.18	12639.11	6610.95
Sum	13464.04	3553.61	33.79441	21.32565
Mean	30.66979	53.84258	8.076751	0.682716
Std. error	0.7277926	5.056953	24397.48	144.4913
Variance	232.5304	1687.803	156.1969	12.02046
Stand. dev	15.24895	41.08288	22.185	18.67
Median	26.83	42.1	15.635	12.2575
25 prcntil	19.08	31.0125	33.2325	26.585
75 prcntil	38.93	62.6525	19.11946	1.438561
Skewness	1.064668	2.671918	368.3147	2.381723
Kurtosis	0.7874726	7.371579	0	18.51928
Geom. mean	27.28004	44.82108	462.1975	56.3662
Coeff. var	49.71976	76.30184		

Platform lengths

	FXJJ50	FXJJ23	FXJJ18IHS	FXJJ20E
N	132	72	225	171
Min	2.69	7.71	4.05	3.35
Max	46.42	57.21	101.65	67.69
Sum	1885.63	1670.87	3984.15	2456.83
Mean	14.28508	23.20653	17.70733	14.36743
Std. error	0.7343133	1.153351	0.72178	0.6809125
Variance	71.17652	95.77581	117.2174	79.28276
Stand. dev	8.436618	9.786512	10.8267	8.904086
Median	12.515	20.95	14.66	12.24
25 prcntil	8.4625	15.78	11.21	8.82
75 prcntil	19.1825	28.065	21.165	17.09
Skewness	1.214715	1.031229	2.938956	2.538762
Kurtosis	1.511627	1.108131	16.36356	9.905634
Geom. mean	12.06772	21.35042	15.39379	12.43087
Coeff. var	59.05896	42.17137	61.14246	61.97412

Principle component analysis of Plat/length

PC	Eigenvalue	% variance
50	60.1229	47.143
23	30.7818	24.137
18	21.2241	16.642
20	15.4031	12.078

PlatformWidh

fxJj50	Fx23	Fx18	Fx20
132	72	439	171
0.83	2.8	4.51	1.13
25.79	19.44	187.41	27.45
741.2	663.102	11195.53	1038.51
5.615152	9.20975	25.50235	6.073158
0.3429428	0.495135	0.685418	0.310446
15.52449	17.6514	206.2412	16.48041
3.940113	4.201357	14.3611	4.059607
4.725	8.435	22.75	5.05
2.735	5.715	16.45	3.34
7.27	12.8375	30.7	7.51
1.984367	0.518827	3.920102	2.010749
5.677904	-0.43433	36.46805	5.758502
4.582225	8.242061	22.66127	5.064251
70.1693	45.61858	56.31286	66.84508