Radiocarbon, Vol 64, Nr 1, 2022, p 35–50 DOI:10.1017/RDC.2021.110

NEW RADIOCARBON DATES FROM ARCHAEOLOGICAL SITES IN PARTS OF IGBOLAND, SOUTHEASTERN NIGERIA

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ABSTRACT. This paper presents new results of radiocarbon (^{14}C) ages from archaeological sites in northern Igboland. The study was designed to shed more light on early human occupation and activities in the study area based on sediments from cave and iron-smelting sites. The approach consisted of ethnographic, archaeological, palynological, and slag analyses; these were complemented with ^{14}C dates. The technology adopted as well as the paleoenvironmental conditions that prevailed during the period of human settlement in both sites was revealed. These data, complemented by ^{14}C dates, highlight the human behavioral and subsistence patterns within the region and are comparable to those from similar sites in southeastern Nigeria.

KEYWORDS: cuesta, guano, human occupation, radiocarbon dates.

INTRODUCTION

Early Archaeological Research in Eastern Nigeria

In southeastern Nigeria, Donald Hartle played a significant, pioneering role in archaeological research. His main focus was on habitation sites and phases of human occupations in caves and rock shelters, specifically in the Nsukka and Afikpo area, which constitute parts of northern Igboland (Hartle 1966, 1967; Andah and Anozie 1980; Chikwendu 1998). At the time, human occupation and cultural developments in Igboland, based on the archaeological excavations of a University of Nigeria, Nsukka farm site by Hartle (a parcel of land donated for agricultural activities), were dated to 2555 ± 130 BP. Pottery recovered from the ceramic phase in the Afikpo cave sites dated to about 2500 BP. This farm site dated is one of the early settlement areas in Nsukka with evidence of crude and thick pottery featuring seed impressions, which indicated human activities there as from about 3000 BP. The occurrence of pottery was used as a distinction between aceramic and ceramic phases in Afikpo. This distinction was interpreted as indicative of a transition from hunting and gathering to food production.

In northern Igboland, Anozie (1979, 1985) noted variants of extinct smelting activities, which gave rise to different slag types observed in Opi, Lejja, Umundu in the Nsukka area and Nwofe community in Abakiliki, Ebonyi State. Pit or bowl furnace types, believed to be the earliest forms of furnaces, were recovered in the area. Anozie (1985) is of the view that the Lejja iron smelters, in addition to the pit or bowl furnaces, made use of other furnace types and perhaps variants of shaft furnaces. This was indicated by different types of slag aggregates including flow slag present there. Okafor (1993), based on the analysis of slag residues, questioned the existence of pit or bowl furnaces in the Nsukka region. He believed that the blocks of slag were formed in slag pits by slag tapping from draught shaft furnace. This position posed some fundamental questions. For instance, how do we account for the very heavy weight of the cylindrical slags when compared with other slag aggregates from slag tapping of shaft furnaces in the Nsukka area? Besides, there are observable original iron ores in and around some of the slag blocks (Okpoko and Ibeanu 1999). Shaft furnaces

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would be expected to produce or/and smelt better than pit/bowl furnace as noted in the Nsukka area. Be that as it may, the radiocarbon (^{14}C) dates from Okafor's research have phased iron smelting technology into three developmental stages, viz early, middle and late stage. The Opi and Lejja iron smelting sites were regarded as early phases based on their furnace type as indicated by cylindrical slag deposit with early radiocarbon dates of 520–200 BC (Okafor and Patricia 1992; Okafor 1993). However, a very earlier date of 2000 BP was obtained from the Lejja iron smelting site (Eze-Uzomaka 2013). The middle and later phases are dated to cal AD 895–AD 1020 and AD 810–AD 1430 and cal AD 1430–AD 1950, respectively. These findings notwithstanding, an aspect of the ecological anthropology of the area that requires attention is in the paleoenvironmental conditions under which these human occupations occurred and the possible plants that constituted the food resources exploited during the early and later occupation of the study area. To achieve these objectives, sediment samples for palynological analyses were collected from two cave sites, Onualor and Ozizza, while iron slag, obtained from the excavations of Eziamaugwu, an iron-smelting site, was subjected to geoarchaeological analyses.

Here we document archaeological investigations of Ojebe-Ogene in Nsukka area in northern Igboland. The sites consist of (i) an iron smelting and (ii) caves sites located in the Ukehe community. In the study area, the Ukehe community was selected for excavation because of the copious evidence of iron smelting activities in the past. In addition, we present results of palynological studies of the deposit of bat guano after our discovery of the Onualor cave. The two sites we believed could enhance our understanding of aspects of our research objective(s), bordering on the sequence of smelting technology compared with dated smelting sites in Nsukka. In addition, at Ozizza cave on the southern edge of the cuesta, the research was geared towards enhancing our understanding of the sequence of human occupation when compared with other cave sites on the cuesta. It was expected that the deposits from the two caves (Onualor and Ozizza) would throw more light on both the paleoenvironmental and possibly the human–landscape interactions in the study area.

Description of the Study Sites

The study areas (iron smelting site and Onualor cave) are located in Ukehe, and Ozizza in Enugu and Ebonyi state (Figure 1). These areas of study are situated in Nsukka-Okigwe-Afikpo trending cuesta (Figure 2). Onuolar Cave, one of the three study locations, is located in the Ukehe community, and is along Nsukka-Okigwe to Afikpo road; the area is characterized by several rock shelters and caves. Onualor cave contains a huge deposit of bat guano of about 1.5 m thick, which formed the basis of the palynological investigation there (Figure 2). The other study sites are an iron smelting site, and Ozizza cave all located in Ukehe Igbo-Etiti Local Government Area and Afikpo in Ebonyi state, southeast Nigeria. The Onualor cave and Eziamugwu iron smelting sites have satellite locations of 60º39'02.2"N, 70º75.27'08.2", elevation 308 m and 60º38'32.4"N, 70º24'39.2"E, elevation 497 m, respectively, while Ozizza is situated at satellite location 5º54'42"N, 7º57'19"E (Figure 1). These study areas are situated in Nsukka-Okigwe-Afikpo trending cuesta (Figure 2). The cuesta trends from north to south with its east-facing scarp slope rising between 200 and 300 m above the Cross River plains. The Cuesta is formed by the resistant sandstones of the Mamu formation and the lower part of Ajalli formation (Ofomata 1978; Obi et al 2001).

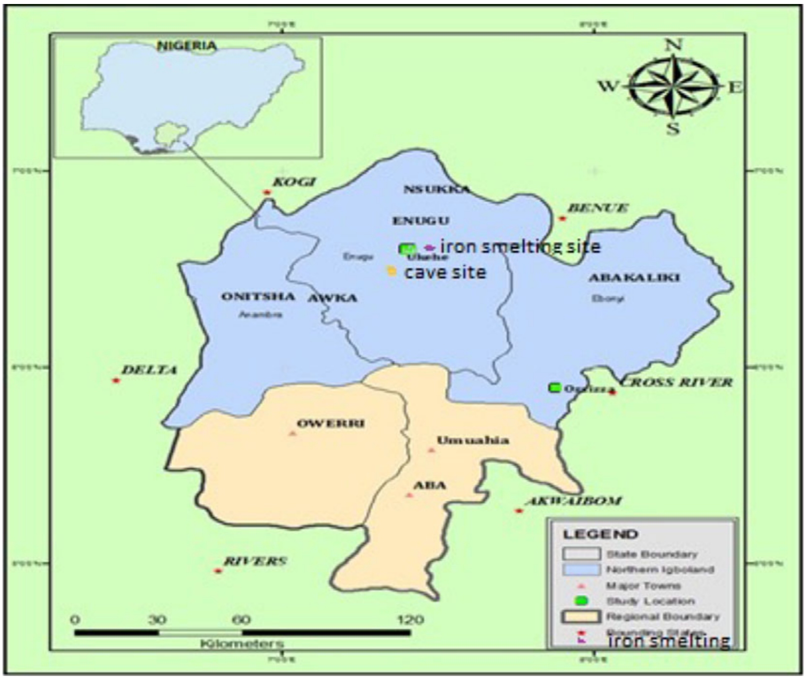

Figure 1 Map of the study area. Green rectangles indicate the iron-smelting sites and caves in Ukehe and Ozizza, respectively. (Please see electronic version for color figures.)

The vegetation of the study region varies from humid to dry with evidence of intense human activities and exploitation of resources trending along the north-south cuesta that gave rise to the dry vegetation. The notable climate is characterized by dry and wet seasons. The region experiences an average of eight months of rainfall between March and October and four months of dry season between November and February. Dominant trees found in the area include Palm tree *Nkwu* (*Elaeis guineensis*), Oha (*Pterocarpus soyauxii),* Bitter kola *Akinu* (*Gacinia cola*), Kola nut *Oji* (*Cola acuminata*), Cashew *Ijikara* (*Anacardium occidentale*), Pepper fruit *Mmimi* (*Denettia tripetala*),Ogirishi (*Newbouldia laevis*), Icheku (*Dialium guineense*), Oil bean *Akpaka* (*Pentaclethra macrophylla*), Native mango *Ujuru* (*Irvingia gabonensis*), Native pear (*Canarium schweinfurthii*), breadfruit *Ukwa* (*Treculia africana*), Star/African apple *Udara* (*Chrysophylum albidum*), and Avocado pear *Ube oyibo* (*Pecia americannum*).

METHODS

The following methods were adopted in the collection of data for this research:

1. Reconnaissance survey and collection of ethnographic data;
2. Excavation of selected sites;
3. Scientific analysis of recovered artifacts/ecofacts;
4. Pollen analysis of guano and sediment samples from the caves; and
5. ^{14}C estimates of charcoal and guano samples collected in stratigraphic contexts. Samples for ^{14}C dating were sent to Beta Analytic Inc.

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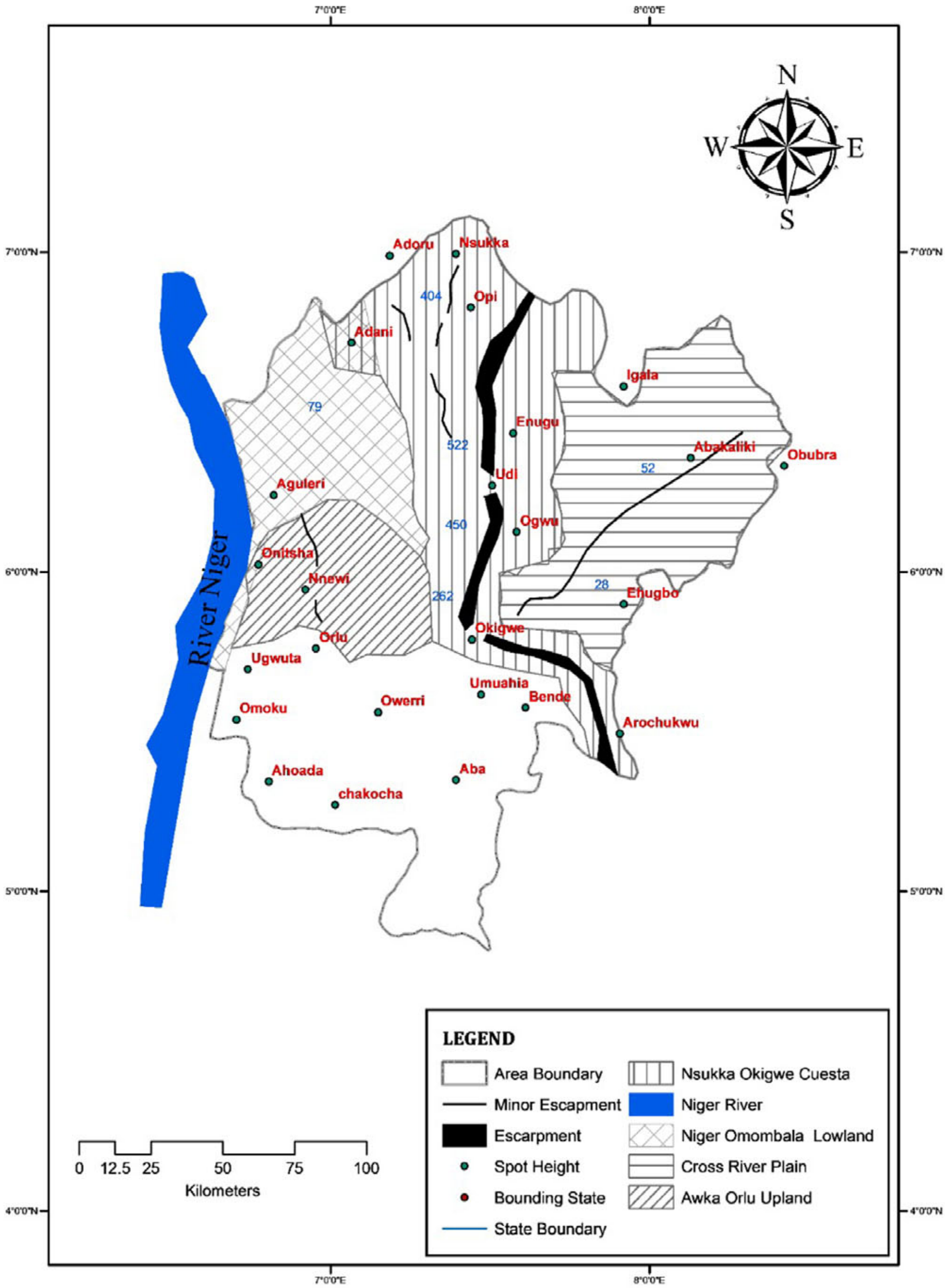

Figure 2 A geology map of the Nsukka-Okigwe-Afikpo cuesta area. The study sites are in red.

From the archaeological reconnaissance and survey, some sites were identified including those with features where iron was smelted in Eziamaugwu in Ukehe, and the Onualor cave filled with bat guano. Observations were made of the current use of the cave for bats and other animals/reptiles as well as for hunting. Data generated from cave and iron smelting sites

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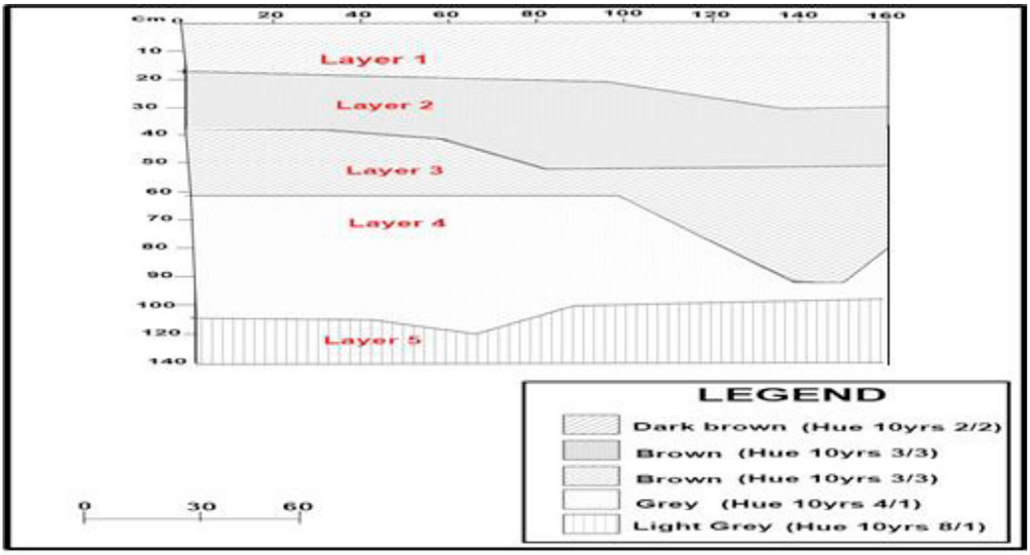

Figure 3 Stratigraphic profile of the southern wall of the Onualor cave excavation.

were sent for further scientific analysis including the radiocarbon dating of both charcoal and guano samples (Table 2). X-ray diffraction analysis was carried out on the slag obtained from the archaeological excavations in Eziamaugwu. Aggregate slag samples discovered from the iron smelting site was used to determine the possible type of furnace used for smelting and the period of iron working following the three developmental phases of iron working technology in Nsukka proposed by Okafor (1993). In Ozizza, a rock outcrop, identified in Ogba-eju Rock Shelter was used as the datum point. The rock outcrop measured 5 feet (ca. 1.5 m) in height and situated adjacent to the rock shelter. Test-pits that measured 2 × 2 m were excavated. A total of number of six spits was dug starting from 0 to 120 cm. Materials recovered included charcoal, potsherds, quartzite, palm kernel, seed husk, snail shells and metal objects.

Radiocarbon Dates

Much reliance would be given to dateable materials (guano and charcoal fragments) from the deepest stratigraphic levels (Figure 3). The charcoal samples were sent for accelerator mass spectrometry (AMS) ^{14}C dating at Beta Analytic Inc. in Florida, USA. These samples were subjected to pretreatment for the removal of contaminations. For the charcoal samples and guano sample at 40–60 cm, the pretreatment was the same. The sample was first visually inspected for size and durability. It was reduced to small particles (1–5 mm) through dissecting and crushing and saturated in de-ionized water at 70ºC. It was then soaked in 0.1N HCL for 1–2 hr and repeated, to eliminate any carbonates present. The sample was then rinsed to neutral; 1–2% alkali was then applied (50/50wt NaOH) at 70°C and repeated until no color change was observed. It was then rinsed to neutral. A final hot acid wash (0.5–1.0 N HCL) was applied to ensure the alkali was neutralized and once again rinsed to neutral, this time using deionized water. During this process all roots and exogeneous organic debris were removed. Samples were dried at 100ºC or desiccated for 12–24 hr, then

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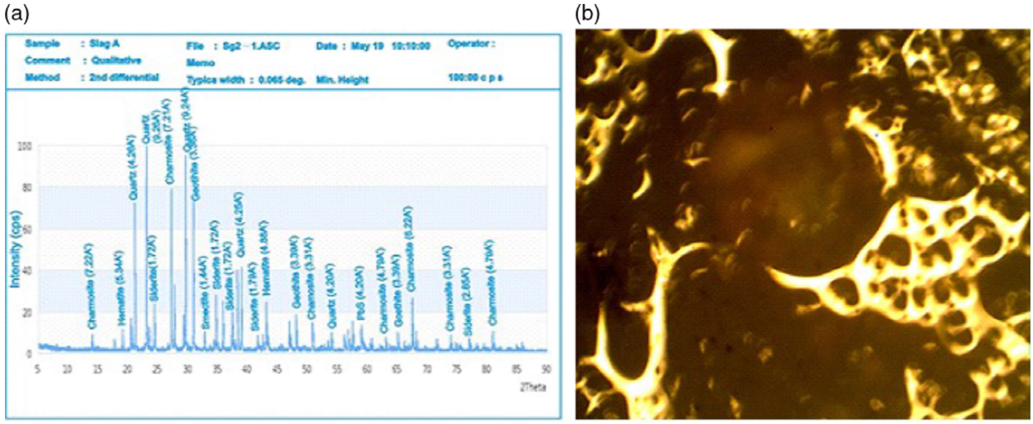

Figure 4 Slag analysis: (a) X-ray diffraction of slag from Eziamaugwu iron smelting site Ukehe; (b) microscope photograph of the (mineral) macerals from Eziamaugwu iron smelting at Ukehe.

microscopically examined for cleanliness, uniformity and, where applicable, appropriately subsampled for the measurements.

Palynology: Onualor and Ozizza

Five samples of bat guano (coprolites) were collected from the five (1–5) stratigraphic layers identified from the excavated 2 × 2 m test pit inside Onualor-Ogadike cave. The depths of layers 5–1 are as follows: 5 (115–140 cm), 4 (62–115 cm), 3 (38–62 cm), 2 (17–38cm), and 1 (0–17 cm). Twenty grams of the guano samples were subjected to pollen analysis. Similarly, in Ozizza, six sediment samples from the six stratigraphic layers of the excavated trench in the cave were subjected to pollen analysis. The laboratory preparation techniques included using HCl, HF, and heavy liquid (ZnCl2) mineral separation. There was no acetolysis because it would likely destroy several of the presumably fragile palynomorphs.

RESULTS

Based on the ^{14}C dates and slag characteristics, slags identified in Ukehe were aggregate and flow slags while the bloom coagulates in ball forms were raked out from the furnace. Slags from Ukehe were similar to those found in Owerre-Elu iron smelting, which was classified under late phase of iron working in Nsukka. X-ray diffraction analysis showed the presence of minerals such as chamosite, haematite, quartz, siderite, goethite, and smectite (Figure 4a). The identified minerals categorized the slag as fayalite (Fe_2SiO_4) with evidence of glass. This is similar to the minerals found in the Owerre-Elu iron smelting site (Okafor 1992). The photomicrograph of the slag showed the occurrence of dark quartz crystal and light grey iron oxide (Figure 4b), which is similar to what was obtained in Owerre-Elu (Okafor 1992).

Palynological Data from Onualor

Pollen count was low (14–35) in almost all the samples except for Layer 3 which yielded 110 pollen grains per pair of slides (Table 1). A total of 44 palynomorph types, and xylem vessels were recovered from the samples; pollen grains were 35 (79.5%), pteridophyte spores were six (13.6%) while fungal spores were four (9.1%); there were two spores of parasitic organisms and

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Table 1 Phytoecological groups and plant groups represented in the Onualor-Ogudike cave pollen assemblage.

Ecological group/archaeological layer	1	2	3	4	5
Rain forest	1	1	26	1	4
Guinea savannah	1	2	9	2	1
Sudan savannah		1		4	
Poaceae			12		4
Open vegetation	1		4		
Montane forests		1			
Secondary forest	2	4	27	3	20
Combretaceae/Melastomataceae			12	1	
Freshwater swamp forest	1		4		3
Miscellaneous			2		
Unidentified	1				2
Monolete spores			1		
Trilete spores			6	1	
Fungal spores			2	3	
Parasitic spore			1		
Xylem vessels			4		
Total	7	9	110	15	35

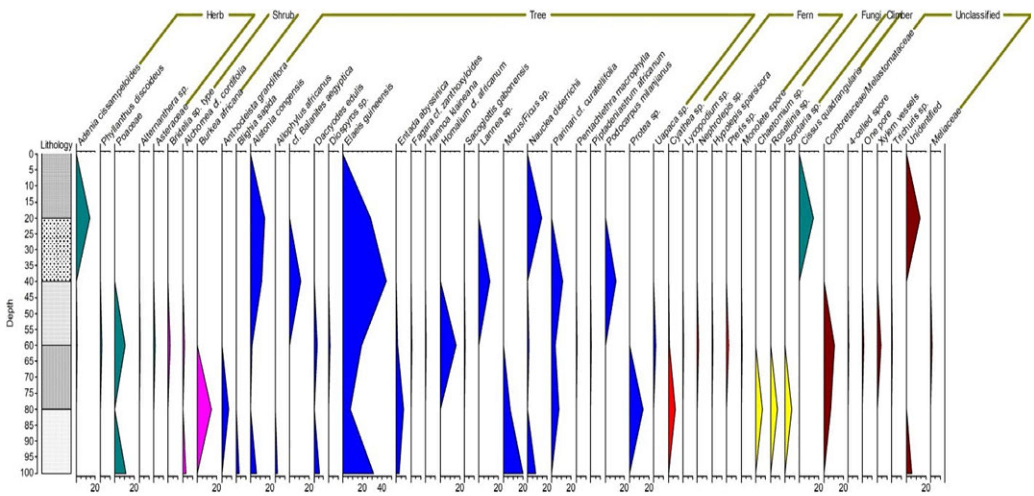

Figure 5 Pollen diagram of excavated Onualor-Ogadike cave herb (green), shrub (magenta), tree (blue), fern (red), fungi (yellow), climber (green), and unclassified (brown).

xylem vessels. Palynomorphs were classified into phytoecological groups based on the natural habitat of their parent plants (Table 1; Figure 5) for ease of interpretation. In Layer 5 (115–140 cm), the dominant palynomorphs are those the parents of which are natural to secondary (open) forests and Guinea savanna. Layer 4 (62–115 cm), showed typical woodland species natural to Guinea and Sudan savanna. For Layer 3 (38–62 cm), several economic plants, namely *Elaeis guineensis*, *Phyllanthus discoideus*, *Dacryodes edulis,* and Combretaceae/ Melastomataceae were the main pollens recovered (Figure 6). In Layer 2 (17–38 cm), there

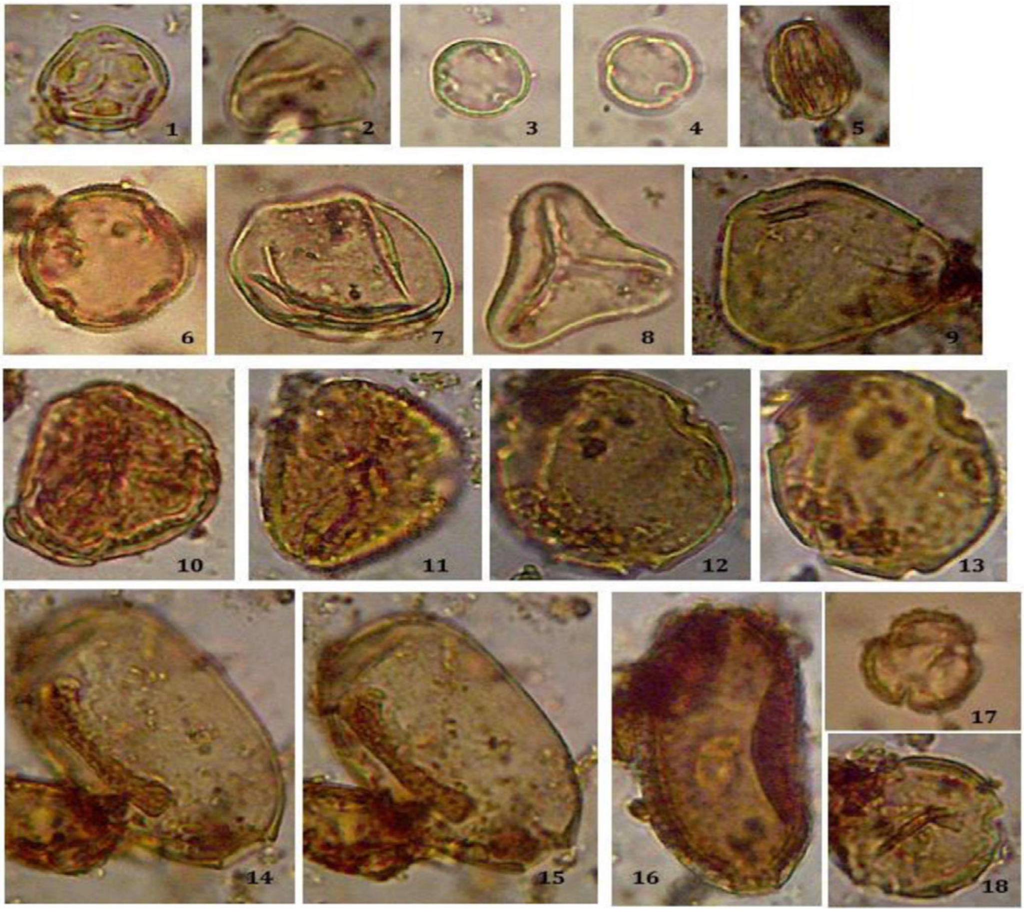

Figure 6 Palynomorphs from bat guano in Onualor-Ogadike cave, southeastern Nigeria: 1. *Alternanthera* sp.; 2. *Protea* sp.; 3–4. *Nauclea diderrichii* 5; Combretaceae/melastomataceae; 6. Meliaceae; 7. Poaceae; 8–9. *Elaeis guineensis*; 10. *Pteris* sp; 11. *Parinari* sp.; 12–13. *Pentaclethra macrophylla*; 14–15. Unidentified; 16. *Trichuris* sp.; 17. *Entada abyssinica*; 18. *Piptadenistrum africanum*.

was a paucity of pollen due probably to poor preservation. Layer 1 (0–17 cm), showed further paucity of pollen and spores; the recovered pollen included *Elaeis guineensis* (Figure 6) which represented secondary forests. The other pollen grains were those of rainforest, freshwater swamp forest, Guinea savanna, and open vegetation (grasses).

DISCUSSION

This study gives evidence of early iron/metal working in pre-colonial period in the northern Igbo communities. Pit/bowl furnace is believed to be earliest furnace and iron smelting technology that was extensively deployed in Opi, Lejja, and Nwofe which produced the "giant" slags not yet reported elsewhere in Nigeria. These sites are contemporaneous with but not earlier than the Nok sites notwithstanding the radiocarbon date of 2000 BC iron smelting site of Lejja in Nsukka area Eze-Uzomaka (2009). Pole (2010) has however, expressed some reservations on the Lejja date. From the available evidence, it could be

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argued that the northern Igboland, Nsukka area, in particular, assumed one of the important centers of iron smelting technology in Nigeria.

This fact was achieved by possibly itinerant iron workers that moved from one location to another based on availability of the raw materials haematite ore and hard wood for charcoal making. For better understanding of the impact of early ironworking the issue of origin(s), according to Pole (2010) need to be de-emphasized because of its implicit racial and/or ethnic superiority. Instead, the socio-cultural, as well as economic contexts, should be explored. This would yield more significant benefit to human societies and understanding of intergroup relations within and between various societies.

The socio-cultural contexts of iron smelting/smiting in the study area has been highlighted by Okpoko and Ibeanu (1999; Eze-uzomaka 2013) and need not be re-emphasized in this paper. However, it should be noted that the present inhabitants of the communities which were once iron smelting sites in Nsukka area are ignorant of the iron smelting processes. Presently, various myths are woven around Lejja iron smelting by the community (Opata and Eze-Uzomaka 2012). This differs from the sites of Umundu in Nsukka that falls within the late phase of iron smelting. In this community as noted by Anozie (1979, 1985) the elders were able to recollect their observation as children how their forebears smelted iron and produced charcoal for smelting. The Umundu elders were asked to re-enact the processes of iron smelting. They built a shaft furnace with mud wall and the experiment was a near success in the Department of Archaeology and Tourism, University of Nigeria, Nsukka.

The interpretation of the pollen data from Onualor indicated that the cave experienced fluctuation in vegetation from the Late Holocene till recent years. For instance, layer 5, the earliest deposit in the cave, had a complex of dry/secondary rainforest and freshwater swamp forest while elements of (wetter) Guinea savanna were also present (Table 1, Figure 8). It likely experienced humid and warm conditions. During Layer 4, dated to 4650 ± 30 BP (Table 2), the inferred vegetation was largely dominated by Guinea savanna (dry type) and Sudan savanna; conditions were very dry and perhaps unfavourable such that the cave might have been temporarily abandoned or had very little human presence. During Layer 3, there was a return to wet conditions and an expansion in rainforest species (Figure 8). In Layers 2–1, marked changes in the surrounding vegetation resulted in sparse trees and shrubs, an event that corresponded to a combination of climatic and human activities. It should be noted that layers 3–1 coincided in part, with increased human impact on the landscape, particularly, the iron smelting activities, in the region. Furthermore, the occurrence of the pollen of edible and economic plants particularly those associated with human habitation especially in Layers 5 and 3 indicated possible human presence during those times.

Palynological studies of sediment samples from Ogba-eju cave in Ozizza revealed an abundance of fern spores (Figure 9). Ferns are particularly prevalent in moist areas. The sediments deposited during the earliest period (120–80 cm) seem to have been fairly humid considering the relatively small number of fern spore types recovered. In the middle section (80–40 cm), the palynomorphs decreased while fern spores decreased significantly; an explanation for this is that conditions became drier leading to the subsequent decrease of the ferns (Table 3). In the latest period (40–0 cm), the increase in the fern communities was an indication that conditions improved. The inferred vegetation changes seem to generally correlate with those of Onualor in the following ways: the earliest levels of

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Table 2 New ^{14}C dates and calibrations from Nsukka-Afikpo on the north-south trending cuesta in Igboland. Calibration program BetaCal3.21 and the IntCal13 calibration curve (Reimer et al. 2013) and NHZ3 bomb peak data for the modern (Hua et al. 2013) were applied. Please see Figure 7(a–f) for calibration curves generated using IntCal20.

Sample/location	Lab number	^{14}C dates (BP)	Calibrated dates
Guano sample from Onualor-Ogadike cave (60–80 cm)	Beta-543519	4650 ± 30 BP	3517–3396 cal BC (5466–5345 cal BP) and 3386–3363 cal BC (5335–5312 cal BP)
Charcoal sample from Ozizza (80–100 cm)	Beta-543522	760 ± 30 BP	1222–1285 cal AD (728–665 cal BP)
Charcoal sample from Ozizza (60–80 cm)	Beta-543523	680 ± 30 BP	1276–1321 cal AD (674–629 cal BP) and 1358–1390 cal AD (592–560 cal BP)
Charcoal sample from Eziamugwu (80–100 cm)	Beta-543524	360 ± 30 BP	1540–1635 cal AD (410–315 cal BP) and 1450–1529 cal (500–421 cal BP)
Charcoal sample from Onualor-Ogadike cave (20–40 cm)	Beta-543521	220 ± 30 BP	1735–1806 cal AD (215–144 cal BP), 1642–1684 cal AD (308–266 cal BP), 1933–post AD 1950
Guano sample from Onualor-Ogadike cave (40–60 cm)	Beta-543520	112.69 ± 0.42 pMC	1958 cal AD 1992 and 1995 cal AD

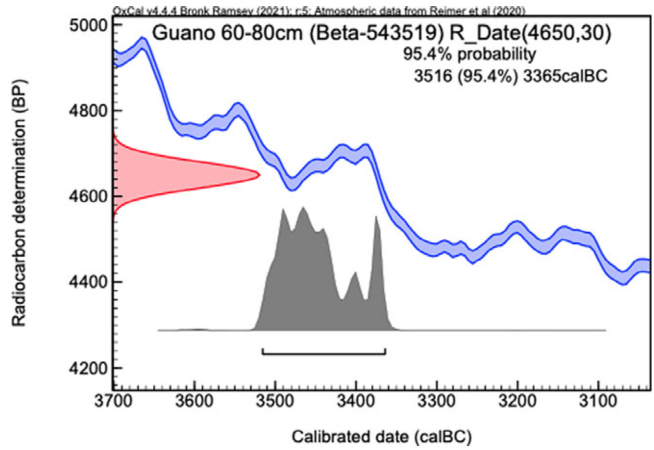

Figure 7a Calibration curve: Guano from 60–80 cm. Lab code Beta-543519.

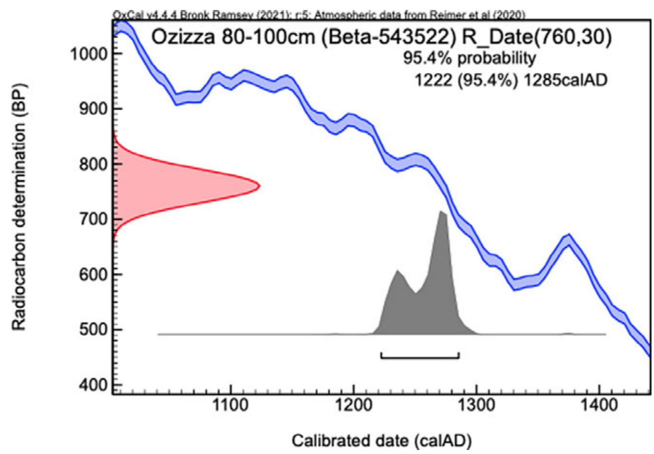

Figure 7b Calibration curve: Ozizza from 80–100 cm. Lab code Beta-543522.

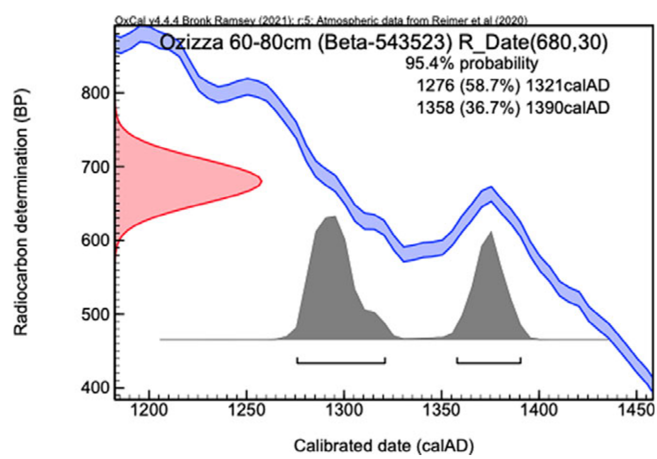

Figure 7c Calibration curve: Ozizza from 60–80 cm. Lab code Beta-543523.

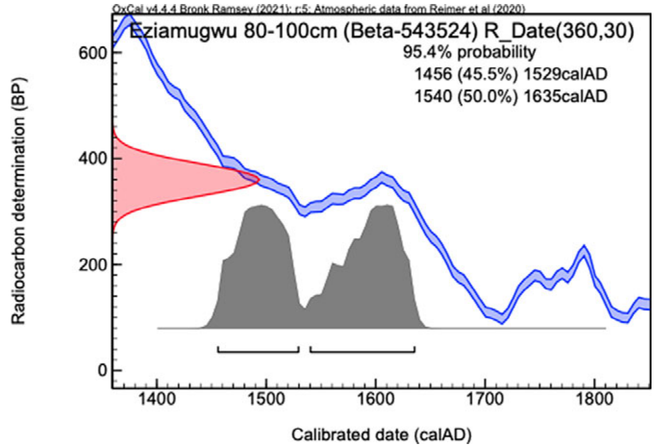

Figure 7d Calibration curve: EI SS charcoal from 80 cm. Lab code Beta-543524.

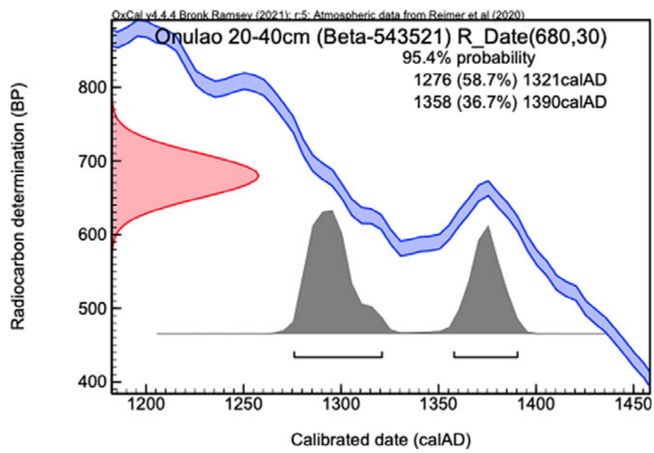

Figure 7e Calibration curve: Onualo charcoal 20–40 cm. Lab code Beta-543521.

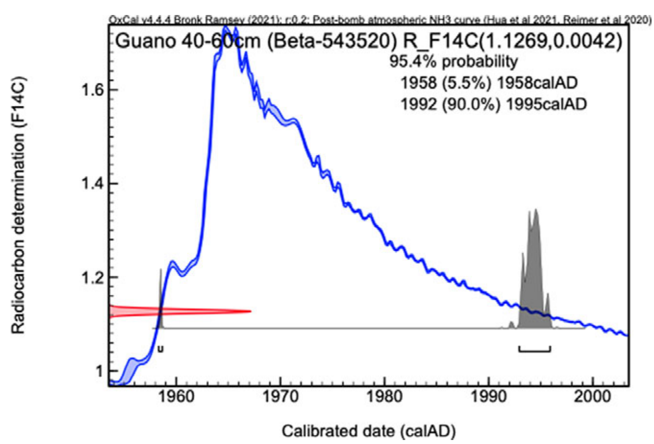

Figure 7f Calibration curve: Guano from 40–60 cm. Lab code Beta-543520.

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Table 3 Palynomorphs represented in the Ozizza cave.

Sample no.	Palynomorph species	Spit I 0–20 cm	Spit II 20–40 cm	Spit III 40–60 cm	Spit IV 60–80 cm	Spit V 80–100 cm	Spit VI 100–120 cm
1	*Cingulatisporites ornatus*	23	41	6	2	2	1
2	*Inaperturopollenitess crisopolensis*	31	53	—	—	—	—
3	*Leptolepidites tumulosus*	33	63	—	—	—	—
4	Baculate spore	17	21	1	—	—	—
5	*Laevigatosporites* sp.	41	32	—	1	—	3
6	*Dictyophyllidites harrisii*	53	72	4	—	—	—
7	*Cyathidites minor*	167	206	—	—	1	1
8	*Araucariacites sp*	2	6	—	—	—	—
9	*Nymphaea lotus*	—	—	—	—	9	11
10	*Pyramidosporites traversei*	—	2	—	—	—	—
11	*Tricolpites* sp.	1	—	3	—	—	4
12	Amaranthaceae	—	—	3	—	—	—
13	*Mauritidites* sp	—	—	—	1	—	—
14	*Monoporites annulatus*	—	—	—	1	—	—
15	*Nyssapollenites peusdocruciatus*	—	—	—	4	—	2
16	*Arecipites* sp.	—	—	—	—	2	—
17	*Stereisporites*sp.	—	—	—	—	2	—
18	*Psilastephanocolporites laevigatus*	1	—	—	—	3	1
19	*Punctatisporites major*	—	2	4	—	2	—
20	*Gleicheniidites* sp	—	—	—	—	4	2

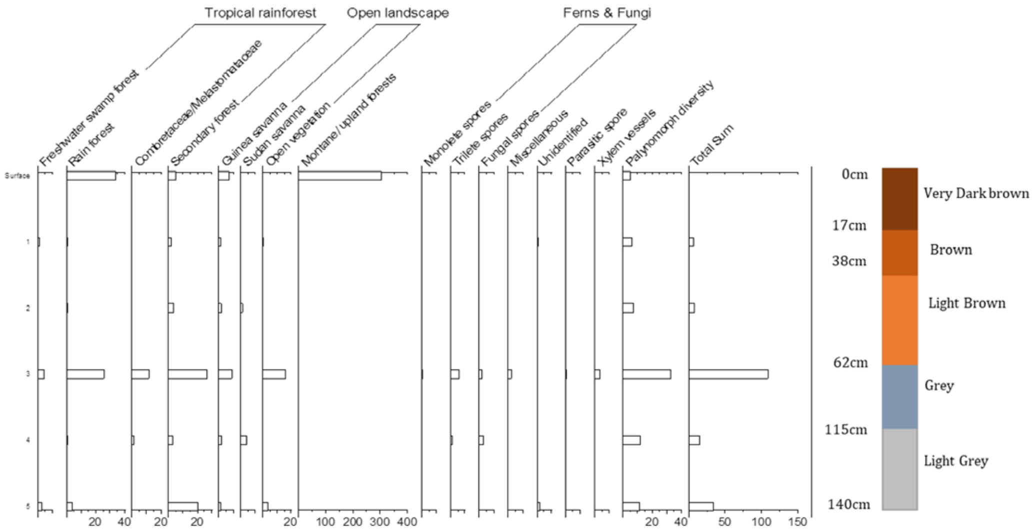

Figure 8 Palaeoecological groups in the excavated unit in Onualor-Ogadike cave, Enugu State, southeastern Nigeria.

Onualor and Ozizza reflected humid conditions which was followed by some dry conditions and then subsequently by wet conditions. However, unlike in Onualor, the impact of humans was not noted in Ozizza. It must however be stated that due to the lack of ^{14}C dates from Ozizza, it is difficult to correlate the data with those from Onualor much less the iron smelting site of Eziamugwu.

CONCLUSION

The results of the study in Onualor cave, Eziamugwu iron smelting site and Ozizza rockshelter seems to suggest evidence of early human activities within the areas. In Onualor, there is evidence of fluctuating environmental conditions from humid to dry and moist in the Late Holocene. Similar palaeoenvironmental conditions were inferred for Ozizza, although it was difficult to correlate Ozizza with the other sites because of the lack of dates.

Furthermore, the presence of these edible plants' pollen possibly suggested the predominant of these plants and human activities in and around the study area. Apart from bat, the presence of high percentage of phosphate in the cave sediment seems to suggest human use and organic decay in the cave as was found in Okigwe cave (Ibeanu 2000). Human migration along the cuesta (Afigbo 1987) seems to suggest movement from Nsukka to Okigwe and lastly to Afikpo area. The early date of Onualor cave, possible period of human settlement tarries with Uhuchukwu in Okigwe dated 4691 ± 78 BP (Umeji et al. 2012), this date showed period of human occupation and activities in the cave which is near to the period of human occupation in Onualor cave while Ozizza seems to suggest the later occupation. The analyses shows the rockshelter in Ukehe and Ozizza indicates the occurrence of past environmental changes as well as the effects of anthropogenic activities in the region. However, the narrow range of dates between Onualor and Okigwe seems to suggest

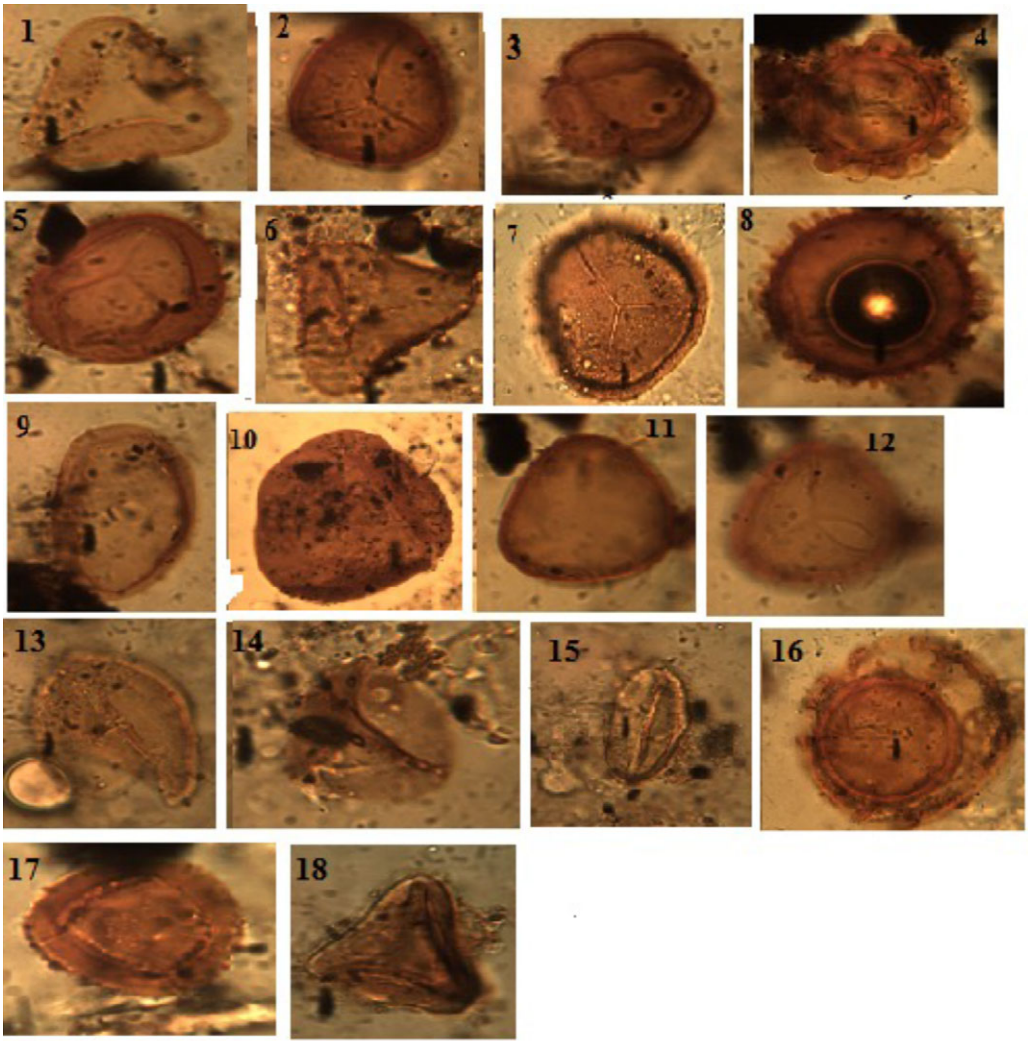

Figure 9 Palynomorphs from Ozizza cave, southeastern Nigeria: 1. *Cyathidites minor*; 2. *Stereisporites*; 3. *Droseridites*; 4. *Distaverrusporites* sp/*Pteris* sp.; 5. *Punctatisporites major*; 6. *Ericipites annulatus Gonza*; 7. *Dictyophyllidites harrisii*; 8. *Cingulatisporites*; 9. *Numulipollis neogenicus*; 10. *Laevigatosporites discordatus Pflong*; 11. *Araucaria cites* sp.; 12. *Stereisporites* sp.; 13. *Mauritidites* sp.; 14. *Monoporites annulatus*; 15. *Psilastephano colporites laevigatus*; 16. *Nymphaea lotus*; 17. *Cingulatisporites ornatus*; 18. *Gleicheniidites* sp.

contemporaneity of human activities in the two caves located to the north and south of the trending cuesta.

ACKNOWLEDGMENT

Our sincere appreciation goes to TETFUND, which provided grants (TETFUND/ DESS/UNI/NSUKKA/2018/RP/ VOL.1 University of Nigeria, Nsukka) for the radiocarbon dating.

REFERENCES

Adeyanju TE, Adeyanju AT, Ottosson U and Manu S. 2017. Bat diversity and abundance in Omo Forest Reserve, Nigeria. Journal of Research in Forestry, Wildlife & Environment 9(4):9–18.

Afigbo AE 1987. Speculation on Igbo origins, dispersal and culture history. In: Afigbo AE, editor. Ropes of Sand. Ibadan: University Press Limited. p. 1–30.

Andah BW, Anozie FN 1980. Preliminary report on the prehistoric site of Afikpo, Imo state Nigeria. West African Journal of Archaeology 10:83–102.

Anozie F. 1979a. Early iron technology in Igboland: Lejja and Umundu. West African Journal of Archaeology 9:119–134.

Anozie F. 1985. Archaeology of Igboland. Nimo: Asele Institute Monography.

Aremu D. A. 2005. Precolonial Nigeria essays in honor of Toyin Falola. In: Akinwuni O, editor. Metallurgical traditions: origins, technology and social implications. p. 136–137.

Carrión JS, Scott L, Marais E. 2006. Environmental implications of pollen spectra in bat droppings from southeastern Spain and potential for palaeoenvironmental reconstructions. Review of Palaeobotany and Palynology 140:175–186.

Chikwendu VE. 1998. Cultural succession and continuity in southeastern Nigeria (excavations at Afikpo). BAR International Series 734.

Daniel KC. 2019. Archaeological investigation of Ojebe-Ogene clan, Enugu state, Nigeria. [unpublished PhD thesis]. University of Nigeria, Nsukka.

Eze-Uzoamaka PI. 2009. Iron Age archaeology in Lejja, Nigeria. In: Pwiti G, Macamo S, Radimilahy C, editors. Dimensions of African archaeology: studies in the African past. Vols. 7E, 7D. Dares Salaam: Vision Publishing Limited. p. 41–51, 40–51.

Eze-Uzomaka PI. 2013. Iron and its influence in the prehistoric site of Lejja. In: Humphris J, Rehren T, editors. Proceedings, World of Iron Conference. p. 3–9.

Fagg B. 1968. The Nok Culture excavation at Taruga, west Africa. Archaeological Newsletter 10.

Fagg B. 1992. Excavation of an occupation site in the Nok valley, Nigeria. West African Journal of Archaeology 2:75

Hartle D. 1967. Archaeology in eastern Nigeria. Nigeria Magazine 93:134–143.

Hartle D. 1966. Archaeology survey in eastern Nigeria. West African Archaeological Newsletter 2.

Hua Q, Barbetti M, Rakowski AZ. 2013. Atmospheric radiocarbon for the period 1950–2010. Radiocarbon 55(4):2059–2072.

Ibeanu A. 2000. A contribution to the archaeology of Okigwe and its environs [unpublished PhD thesis]. University of Nigeria, Nsukka.

Ikegwu J. 2014. Archaeological study of Ozizza in Afikpo north local government area, Ebonyi state, Nigeria [unpublished PhD thesis]. University of Nigeria, Nsukka.

Obi GC, Okogbue CO, Nwajide CS. 2001. Evolution of Enugu Cuesta: a tectonically driven erosional process. Global Journal of Pure Applied Sciences 7:321–330.

Ofomata GEK. 1978. Environment & man. In: Ofomata GEK, editor. The Nsukka Environment, Enugu, Fourth Dimension Publishers. p. 475–486.

Okafor E. 1992. Early iron-smelting in Nsukka, Nigeria: information from slags and residues [unpublished PhD thesis]. Sheffield: University of Sheffield.

Okafor E. 1993. New Evidence on early iron smelting from southeastern Nigeria. In: Shaw T, Sinclair P, Andah B, Okpoko A, editors. The archaeology of Africa: food, metals and towns. London: Routledge Publishing.

Okafor E, Patricia P. 1992. New ^{14}C ages from Nsukka, Nigeria, and the origins of African metallurgy. Antiquity 66:686–688.

Okaigbo BN. 1980. Ahiajioku lecture. Published by Imo State Ministry of Culture.

Okpoko AI, Ibeanu AM. 1999. Early metal-working in Nigeria. In: Okpoko AI, editor. Africa's indigenous technology: with particular reference to Nigeria. Ibadan, Nigeria: Wisdom Publishers. p. 34–46.

Opata C, Eze-Uzomaka P. 2012. Beyond stereotypes: gender and politics in iron smelting society of Lejja, Nigeria. Asian Journal of Social Sciences & Humanities.

Pole LM. 2010. The hammers of Mawu: ironworking traditions in the Togo Hills, Ghana. African Archaeology Review 27:43–78.

Reimer PJ, Bard E, Bayliss A, Beck JW, Blackwell PG, Bronk Ramsey C, Buck C, Cheng H, Edwards RL, Friedrich M, Grootes PM, Guilderson TP, Haflidason H, Hajdas I, Hatté C, Heaton TJ, Hoffmann DL, Hogg AG, Hughen KA, Kaiser KF, Kromer B, Manning SW, Niu M, Reimer RW, Richards DA, Scott EM, Southon JR, Staff RA, Turney CSM, van der Plicht J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887.

Umeji P, Ibeanu M, Agwu C. 2012. Holocene human occupation of the eastern Nigerian scarp lands: an impact assessment study. Quaternary International 262(7):2–13.

https://doi.org/10.1017/RDC.2021.110 Published online by Cambridge University Press