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The beginning of the Iron Age south of the Congo rainforest: the first archaeological investigations around Idiofa (Congo), *c.* 146 BC – AD 1648

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ABSTRACT

Archaeological investigations of the Idiofa region in the Kwilu Province of the Democratic Republic of Congo have yielded the earliest evidence for iron production, combined with ceramics and lithic artefacts, south of the Congo rainforest during the second century BC. Palaeoecological data show that the producers of this industry did not settle in open grasslands but in a habitat where the forests had started to undergo climate-induced degradation before their arrival. The Early Iron Age at Idiofa continues until the third century AD and is followed by a long hiatus that was not driven by climate change until the fifteenth century. Later Iron Age (LIA) pottery in the area, which dates to *c.* 1487–1648, is markedly distinct from that of the EIA in vessel forms, size, recipe and decoration. EIA pottery from Idiofa resembles most closely slightly younger Kay Ladio pottery (*c.* cal. AD 30–475) from the Lower Congo region further west, which is also associated with the first metallurgy there. Idiofa's LIA pottery is indicative of a fifteenth- through seventeenth-century exchange network between the Kamtsha and Kasai Rivers. These shifting dynamics in pottery production are reflected in the region's linguistic stratigraphy, which may contribute to the interdisciplinary reconstruction of the history of ancestral Bantu speakers south of the rainforest.

RÉSUMÉ

Les recherches archéologiques dans la région d'Idiofa, dans la province du Kwilu, en République Démocratique du Congo, ont mené à la découverte des premières traces de la production du fer au sud de la forêt du bassin du Congo. Elles remontent au cours du deuxième siècle avant J.-C et sont associées à la céramique et aussi aux vestiges lithiques. Les données paléoécologiques montrent que les producteurs de cette industrie ne se sont pas installés dans des savanes ouvertes, mais dans un habitat dont les forêts avaient commencé à se dégrader avant leur arrivée, suite aux changements climatiques. L'Âge du

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Fer ancien à Idiofa continue jusqu'au troisième siècle de notre ère. Après cela un long hiatus non lié au changement climatique perdure jusqu'au quinzième siècle. La poterie de l'Âge du Fer récent (*c.* 1487–1648 ap. J.-C.) se distingue nettement de celle de l'Âge du Fer ancien par la forme, la taille, la composition et la décoration. La poterie de l'Âge du Fer ancien d'Idiofa ressemble davantage à la poterie Kay Ladio (*c.* 30–475 ap. J.-C.) de la région du Bas-Congo, située plus à l'ouest et de date un peu plus récente. Elle est également associée à la métallurgie la plus ancienne de cette région. La poterie d'Idiofa de l'Âge du Fer récent est révélatrice d'un réseau d'échange qui s'étendaient entre les rivières Kamtsha et Kasai du quinzième au dix-septième siècles de notre ère. Ces dynamiques en mutation dans la production de la poterie se reflètent dans la stratigraphie linguistique de la région, ce qui est pertinent pour la reconstruction interdisciplinaire de l'histoire des communautés bantouphones ancestrales au sud de la forêt tropicale.

Introduction

The initial dispersal of Bantu languages and the communities speaking them across Africa had a major impact on both the continent's linguistic, cultural and demographic history and its present-day outlook and is therefore a subject of ongoing debate in different research fields (e.g. de Maret 2013; Russell *et al.* 2014; Bostoen *et al.* 2015a; Grollemund *et al.* 2015; Patin *et al.* 2017; Bostoen 2018, 2020; Crowther *et al.* 2018; Wang *et al.* 2020; de Saulieu *et al.* 2021; Seidensticker *et al.* 2021; Koile *et al.* 2022). Insights from linguistics and genetics concur in showing that migration was the principal population dynamic behind the spread of this sub-branch of the Niger-Congo language phylum originating in West Africa (Tishkoff *et al.* 2009; de Filippo *et al.* 2012; Pickrell *et al.* 2012; Schlebusch *et al.* 2012; Li *et al.* 2014; Dimmendaal and Storch 2016; Schlebusch and Jakobsson 2018; Good 2020; Bostoen *et al.* in press a).

In archaeology, many (e.g. Oslisly 1993; de Maret 1994; Wotzka 2001; Clist 2006a; Bostoen, 2019) have argued that the initial stages of this major late Holocene population event, commonly known as the Bantu Expansion, are associated with the spread of new, more sedentary lifeways across the Congo rainforest during the first millennium BC. Those settlements yield material cultures that are significantly different from those of earlier forest dwellers and are characterised by variable combinations of archaeological features new to the region, such as refuse pits (Wotzka 2001), pottery (de Maret 1986; Wotzka 1995), large stone tools (Clist 2006b) and evidence for plant cultivation and/or animal husbandry (Neumann *et al.* 2022) and (later) sometimes also of metallurgy. Nonetheless, in the absence of written records and ancient DNA, identifying traces of the Bantu Expansion in Central Africa's archaeological record is a challenging enterprise (Eggert 2005, 2016). Debates therefore persist on the most basic questions, including its precise pathways and chronology (Russell *et al.* 2014; Grollemund *et al.* 2015; Koile *et al.* 2022), whether it was driven by agriculture or palaeoclimatic change (Schwartz 1992; Bayon *et al.* 2012, 2019; Neumann *et al.* 2012b; Bostoen *et al.* 2015a; Clist *et al.* 2018a; Garcin *et al.* 2018a) and whether settlement was continuous following the initial migration or interrupted by a hiatus between the Early Iron Age (EIA) and the Late

Iron Age (LIA) (Oslisly 2001; de Maret 2003; Wotzka 2006; Oslisly *et al.* 2013; Clist *et al.* 2021; de Saulieu *et al.* 2021; Seidensticker *et al.* 2021; Bostoen *et al.* in press b). Significant voids in the archaeological documentation of the Congo rainforest and its margins hamper serious progress in these matters. One of those archaeologically unknown key zones is the area immediately south of the rainforest where several studies have situated a major secondary hub of Bantu Expansion (Heine *et al.* 1977; Vansina 1995; Grollemund *et al.* 2015; Pacchiarotti *et al.* 2019; Koile *et al.* 2022), especially the zone east of the Congo River and south of the Kasai-Kwa Rivers. For this reason, the area has been the centrepiece of archaeological field research within the interdisciplinary BantuFirst project (https://www.bantufirst.ugent.be) since 2018 (Seidensticker *et al.* 2018; Matonda Sakala *et al.* 2019, 2021; Coutros *et al.* 2022, 2023).

This article focuses on the archaeological surveys and excavations that the BantuFirst team carried out in the eastern end of that area, i.e. within the vicinity of Idiofa, between 18 August and 3 September 2019. The results of this research include several significant findings that help fill important gaps in our understanding of the history of the southwestern rim of the Congo Basin. While the archaeology of the wider region has seen an uptick in recent years, most of this work has focused on the Kongo-Central province of the Democratic Republic of the Congo (Congo-Kinshasa) bordering the Atlantic Coast (Clist *et al.* 2019a, 2019b). More inland regions generally, including all of Kwilu and Kwango provinces, as well as the majority of the neighbouring Kasai and Mai-Ndombe provinces, remain largely unexplored archaeologically. Prior to the present work, the closest archaeological excavations were located ~100 km to the southwest of Idiofa at the sixteenth-century AD site of Mashita Mbanza, itself something of an archaeological island (de Maret and Clist 1985; Pierot 1987). Earlier archaeological collections were carried out by Bequaert (1947) near Tshikapa and in the Kwango region (Bequaert 1956b) and by van Moorsel (1970) along the lower reaches of the Kasai and Lukenie Rivers. Bequaert (1956a) also conducted a series of excavations across the former Belgian Congo, including at Dinga and Mukila, both in the *Territoire de Kenge*. More recently, as part of the BantuFirst research project, Seidensticker *et al.* (2018) revisited Mukila to explore further the late Pleistocene and Holocene sequences that Bequaert had uncovered. However, due to the inconsistent and diffuse nature of archaeological research across the southwestern edge of the Congo Basin, very little is currently known about the region's pre-modern history and how it fits into the broader narratives of Central African history regarding — among other major questions — the spread of food, iron and pottery production and the expansion(s) of Bantu-speaking peoples.

Linguistic research within this region is somewhat more advanced. Based on the most comprehensive lexicon-based phylogeny of the West-Coastal Bantu languages to date, Pacchiarotti *et al.* (2019) have placed the homeland of this major branch of the Bantu family between the Kamtsha and Kasai Rivers, approximately 350 km further east than previously thought based on less exhaustive phylogenies (de Schryver *et al.* 2015). This is the area where the greatest present-day linguistic diversity within West-Coastal Bantu can be observed. According to Pacchiarotti *et al.* (2019), after Proto-West-Coastal Bantu speakers emerged south of the rainforest, there would have been two distinct westward movements from the homeland in the interior toward the Atlantic coast coinciding with the two main sub-branches emerging from the phylogeny, namely Kwilu-Ngounie and the Kikongo Language Cluster (KLC) Extended. The latter sub-branch consists of the KLC, which stretches out from the Kwilu River all the way through the Lower Congo region to the Atlantic Coast, and its closest relatives currently spoken around Idiofa and Kikwit. One of these is Mbuun, the main local language spoken around Idiofa, and the easternmost of the KLC Extended languages. Hence, from an historical linguistic point of view, the Mbuun-speaking area round Idiofa is situated at the extreme eastern end of an ancient east-to-west language expansion of Bantu languages, and possibly also of the people speaking them. However, due to the dearth of archaeological research within this region, no data on occupation chronologies, pottery traditions or technological change exist against which this hypothesis may be tested.

Idiofa

The city of Idiofa lies 485 km east of Kinshasa in the province of Kwilu, to the south of the Kasai River between the valleys of the Kamtsha and Loange Rivers. The city occupies the summit of one in a series of massifs established by the erosion of Upper Cretaceous-Cenozoic Kalahari duricrust and the underlying red sandstone of the Kwango Group (Schwartz 1990; Linol *et al.* 2015). This succession reaches approximately 700 m a.s.l. and is capped by sandy ferralic arenosols (Nicolaï 1963; Datok *et al.* 2021). Today, although receiving an average of 900–1000 mm of annual rainfall, the region is defined as a forest-savanna mosaic, while vegetation zones generally follow topographic gradients, with the massif summits dominated by herbaceous and semi-wooded savannah and the lower valleys having dense patches of Guinean forest species (Nicolaï 1963; Mushi *et al.* 2019).

The main objective of the 2019 BantuFirst field season was to identify and map all archaeological phenomena from within the study region, with a particular focus on Early Iron Age deposits dating from *c.* 300 BC – AD 1000. Through a combination of informal reconnaissance, pedestrian survey and targeted excavation, the BantuFirst archaeology team identified 41 sites ranging from the EIA to the Late Iron Age (Figure 1). In Mbuun, abandoned villages are called '*eyum*'. Excavations were conducted at several *eyum* near the modern villages of Ingung Kapia and Musanga, to the north and south of Idiofa respectively. Here, four units were excavated at Ingung Kapia (4°86'S 19° 57'E) and 47 units were excavated near Musanga at Nkar (4°98'S 19°59'E), Okwon (4°99'S 19°6'E), Isem (4°99'S 19°59'E) and Esal (4°59'S 19°35'E); the last three of these sites take their names from Mbuun clan names (De Decker 1950).

Of primary concern for the above discussion on the early expansion of ancestral West-Coastal Bantu speakers is the EIA occupation of the Idiofa region. Analysis of both phytoliths and soil geochemistry has shown that the region underwent climate-induced forest contraction well before the earliest evidence for occupation of Idiofa. In line with the assumption that the Bantu Expansion was facilitated by such a forest crisis (Schwartz 1992; Bostoen *et al.* 2015; Grollemund *et al.* 2015), climate change may have aided the settlement of new pottery- and iron-producing people in the study area. Here, we have also identified the earliest evidence for iron production south of the Congo rainforest, dating it to the first and second centuries BC. While no ground or polished stone tools were recovered, these iron-using populations may have maintained a degree of technological continuity through the use of knapped stone tools. Such a technological continuity is widespread, if not common, throughout Central

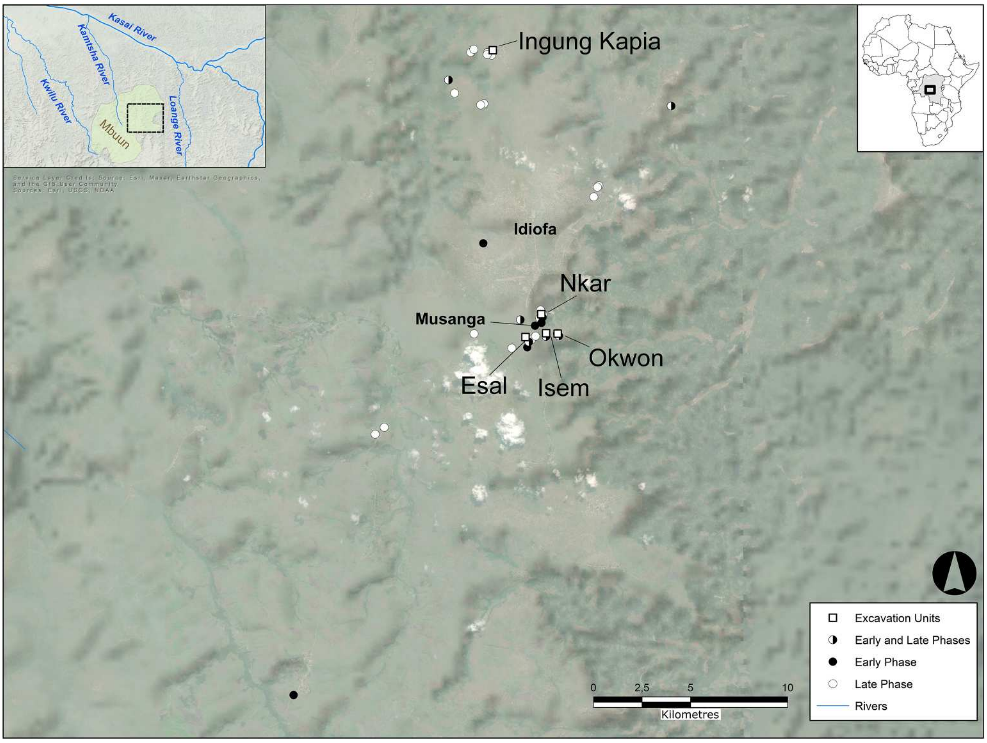

Figure 1. Idiofa Region Survey results shown by survey collections (black circles) and excavation units (white squares).

Africa during the EIA (Clist 2021: 72) and may represent the earliest stages of the adoption of this new technology. Nangara-Komba in the Central African Republic is perhaps the best example (Lupo *et al.* 2021). In more recent periods, a long-distance trade network appears to have operated throughout the Kamtsha-Kasai River network from Mashita Mbanza in the south to Eolo in the north. Dating to the fifteenth through seventeenth centuries AD, this is represented by pottery quite distinct from that of the coeval Kongo kingdom, which was located immediately to the west. Below, we provide a detailed description of these results and their contexts, building upon the preliminary report published by Matonda Sakala *et al.* (2019).

Survey

Our survey was conducted by foot and by car and was oriented on various axes along the summit of the large (~9-km-wide) sandstone massif upon which modern Idiofa sits (Figure 1). Work was largely focused on the periphery of Idiofa, particularly near the villages of Ingung Kapia, Ingung Ateng, Elom Idiofa, Bea Impanga, Impanga Mopila, Inswem Mbel and Musanga. A total of 41 artefact-bearing localities were identified within the study region, including ceramic concentrations, slag and lithic scatters. Diagnostic sherds and lithic artefacts were collected from each site encountered, while the presence of slag on the surface was only noted. If a locality yielded a promising amount of surface finds, a 5 cm auger was used to assess the presence, character and depth of any sub-surface deposits down to 1 m. Over the course of the survey, it became apparent that the most promising locations for excavations were within the vicinity of Musanga to the immediate south of Idiofa.

Excavations

In total, 51 units were excavated within the study area. Units measured 1 × 1 m and were generally excavated in linear axes oriented to the cardinal directions and spaced at intervals determined by the local conditions. As the natural horizons measured between 40 and 60 cm thick, more precise stratigraphic context was defined through the excavation of 20-cm-thick artificial spits. All units were excavated to a depth of at least 1 m below the surface and continued 20 cm below the final artefact-bearing levels to ensure the presence of archaeologically sterile soil. All cultural material recovered during excavations was collected in labelled bags and transported to Kinshasa for further study. In addition, a series of soil samples for archaeobotanical, palaeoecological and soil isotope analysis was taken from excavation units (referred to in this paper as 'Tr.') at both Nkar (Tr. 41 and 47) and a sterile excavation profile at Okwon (Tr. 7) to provide a background signal unaltered by cultural deposits.

As evidenced by the stratigraphy of most of the excavation units, the cultural deposits within the Idiofa region followed a relatively similar pattern. The A horizon extended between 0 and 5 cm below the surface, while from 5–40 cm most units maintained dense cultural deposits within a dark sandy loam horizon. Between 40 and 60 cm was an archaeologically sterile horizon of brown sandy loam, followed by a second, less dense cultural horizon from 60–120 cm within a yellowish loamy sand. Below this deepest cultural horizon was an archaeologically sterile horizon of yellow sand. There were exceptions, however, whereby the upper horizon and cultural material extended deeper (Okwon Tr. 05, 10, 14, 16; Nkar Tr. 37; Isem Tr. 20, 21, 22; and Ingung Kapia Tr. 2), but this material never reached below 65 cm from the surface. Conversely, the lower horizon at Isem Tr. 29 was encountered after only 20 cm. These exceptions notwithstanding, the general pattern of the first (60–120 cm) and second (0–40 cm) occupations being separated by ~20 cm of archaeologically sterile soil was maintained across the vast majority of units.

Table 1. Radiometric dates on wood charcoal collected from Idiofa region by age. Depths are in cm below the surface.

Laboratory number	Site	Unit	Depth (cm)	Material	Date BP	Calibrated date (95.4%)
Beta-630484	Okwon	Tr 11	0–20	Wood charcoal	122 ± 0.46	cal. AD 1821–1932
Beta-630485	Okwon	Tr 11	20–40	Wood charcoal	350 ± 30	cal. AD 1487–1648
RICH-27763	Okwon	Tr 05	80–100	Wood charcoal	1194 ± 26	cal. AD 772–989
Beta-630482	Esal	Tr 30	20–40	Wood charcoal	1250 ± 30	cal. AD 690–953
RICH-27764	Okwon	Tr 16	60–70	Wood charcoal	1903 ± 25	cal. AD 77–226
RICH-27768	Nkar	Tr 47	80–100	Wood charcoal	1938 ± 25	cal. AD 57–205
RICH-27765	Okwon	Tr 11	60–80	Wood charcoal	1977 ± 26	cal. AD 42–192
RICH-27766	Okwon	Tr 12	70–80	Wood charcoal	2019 ± 25	50 cal. BC – cal. AD 73
RICH-27767	Nkar	Tr 41	95	Wood charcoal	2052 ± 26	65 cal. BC – cal. AD 61
RICH-27769	Nkar	Tr 42	100–120	Wood charcoal	2103 ± 25	146–18 cal. BC

The absolute occupation chronology of the region was defined by ten radiometric dates collected from nine excavation units (Table 1). All the dates were analysed by the Radiocarbon Dating Laboratory at the Belgian Royal Institute for Cultural Heritage (KIK-IRPA) and Beta Analytic and were calibrated using OxCal 4.4 with the SHCal20 calibration curve for the Southern Hemisphere within 2σ (Bronk Ramsey 2009; Hogg *et al.* 2020). The results show three general periods of occupation, largely corroborating the finds of the ceramic seriation (see below) and the stratigraphic analysis (Figure 2). The earliest cluster, taken from the orange loamy sand horizon between 60 and 120 cm below the surface, consists of six overlapping dates that span the period from cal. 146 BC – cal. AD 226. A second cluster, including two dates between cal. AD 690 and 989, was taken from the archaeologically sterile horizon of Okwon Tr. 5 and Esal Tr. 30. Finally, one sample, dated to cal. AD 1487–1648 (350 ± 30BP; Beta-630485), was retrieved from the dark sandy loam horizon between 20 and 40 cm. The nineteenth/twentieth-century date (122 ± 0.46 BP; Beta-630484) from Okwon Trench 1 was taken from within the A horizon near the surface of the unit and reflects the modern occupation of the area.

Concerns over the nature and integrity of archaeological deposits at open-air sites in Central Africa have been raised since the 1970s (Cahen and Mortlemans 1973). However, there are several reasons to believe that, at Idiofa, there has been neither inter- nor (significant) intra-horizon mixing. The consistent stratigraphy across all the units within the entire Idiofa region is strong evidence for *in situ* deposition rather than any mass transport of the archaeological materials (i.e. colluvium). While not the 'pits' often targeted at

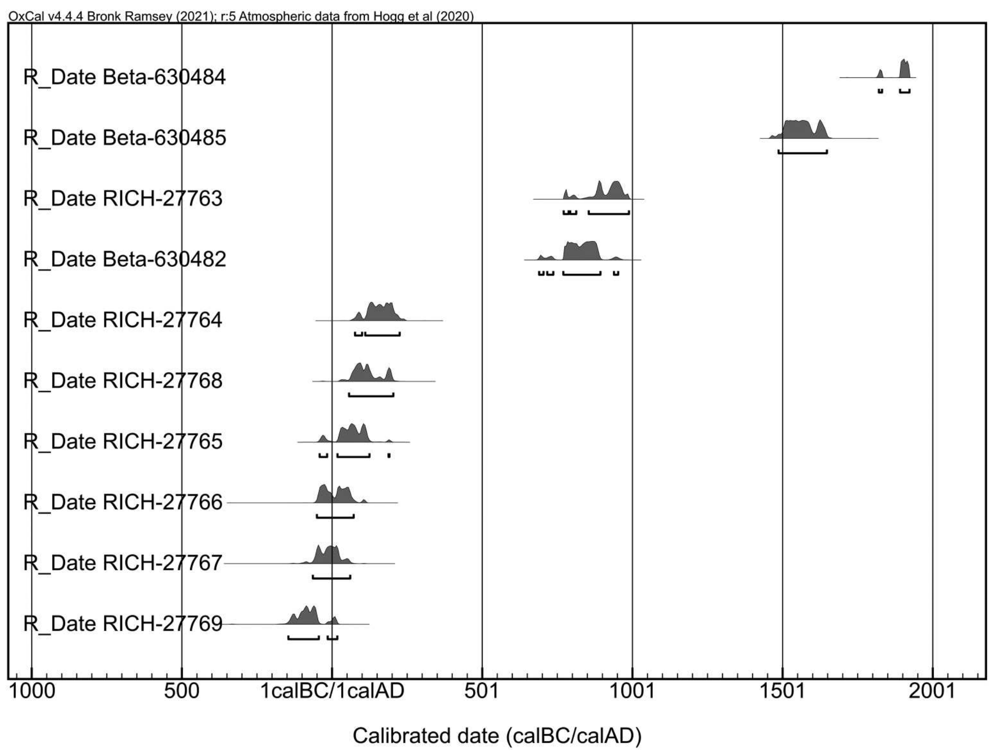

Figure 2. Radiometric dates from the Idiofa Region calibrated using OxCal 4.4 with the SHCal20 calibration curve for the Southern Hemisphere within 2σ.

Central African sites, the Idiofa archaeological deposits are interpreted as occupation debris generally found in discreet 10–20 cm lenses, something captured particularly well in the 10-cm-thick spits excavated at Okwon Tr. 11–18. The distribution of these thin Early Phase deposits likely represents shifting settlement patterns across the four centuries of occupation. This is most clearly shown in Iseme Tr. 29 (see below) where there are two distinct Early Phase occupation deposits between 20 and 40 cm and again at a depth of 80 cm. Likewise, in Nkar Tr. 42–41 one occupation is dated to the first century BC and a distinct second occupation in Tr. 47 to the first century AD; both contain similar Early Phase ceramic material.

The presence of the archaeologically sterile horizon is also significant, as it indicates that there was no inter-horizon mixing or downward migration of archaeological materials from the Late Phase into the Early Phase deposits. This is particularly important at Nkar Tr. 40–47 and Okwon Tr. 10–15, where the earliest evidence for iron production and the co-occurrence of iron slag and lithic artefacts were found respectively. Likewise, the stratigraphic position of all the dates collected suggests a limited vertical movement of materials, for example at Nkar, where the three wood charcoal samples were taken from the 100–120 cm spit (Tr. 42), at 95 cm (Tr. 41) and the upper half of the 80–100 cm spit (Tr. 47), produced sequential dates in stratigraphic alignment. Further, below the A Horizon, the stratigraphy does not show any evidence for bioturbation; no meaningful root systems and no evidence for termites or small animal burrows were encountered. Thus, although the archaeological deposits at Idiofa represent an open-air occupation, the apparent stratigraphic integrity affirms the association between the artefacts and the radiometric dates as presented below.

Nkar

Nkar is located to the northeast of Musanga, on the eastern slope of the massif. The vegetation lacks any fruit or palm trees and is instead composed of savanna shrub species such as *ikɔs* (*Hymenocardia acida*) in Mbuun, short grasses, wild fruits (*ɩfʊŋ́*, *Anisophyllea quangensis*) and a scattering of cassava fields (Figure 3). Pedestrian survey located several small surface concentrations of pottery along the edge of a large depression leading to the valley below. Surface material was also found on the upland extensions of the massif that border the depression to the north, south and west. Based on these finds, thirteen units were opened across the Nkar area: eight around the eastern edge of the depression and another five on the northern and southern adjacent uplands.

The two units were placed on the summit of the upland to the north (Tr. 38–39) and three to the south (Tr. 35–37) of the depression. These units, as well as further auger soundings across the upland areas, produced few archaeological materials in the upper 20 cm, suggesting an ephemeral deposition during the later phase. On the edge of the depression, however, as auger testing yielded cultural material to a depth of ~92 cm, eight adjacent 1 × 2 m units (Tr. 40–47) were excavated to a depth of 140 cm. Here, in addition to a small amount of more recent material within the upper 25 cm, excavations recovered evidence for an early occupation between 80 and 120 cm below the surface (Figure 4). This includes an Early Phase deposit that stretched across Tr. 42 and Tr. 41 that yielded pottery, iron slag and two dates: 146–18 cal. BC (2103 ± 25; RICH-27769) from the 100–120 cm spit and 65 cal. BC–cal. AD 61 (RICH-27767) from a

Figure 3. Backfilling of Nkar Tr. 40–47 facing south. Hashing on the grid layout indicates non-excavated units.

depth of 95 cm. In addition to cultural material, three soil samples were taken from these lower artefact-bearing levels, including one from Tr. 41 (90–100 cm) and two from the north wall of Tr. 47, one at 100–110 cm and the other at 110–120 cm.

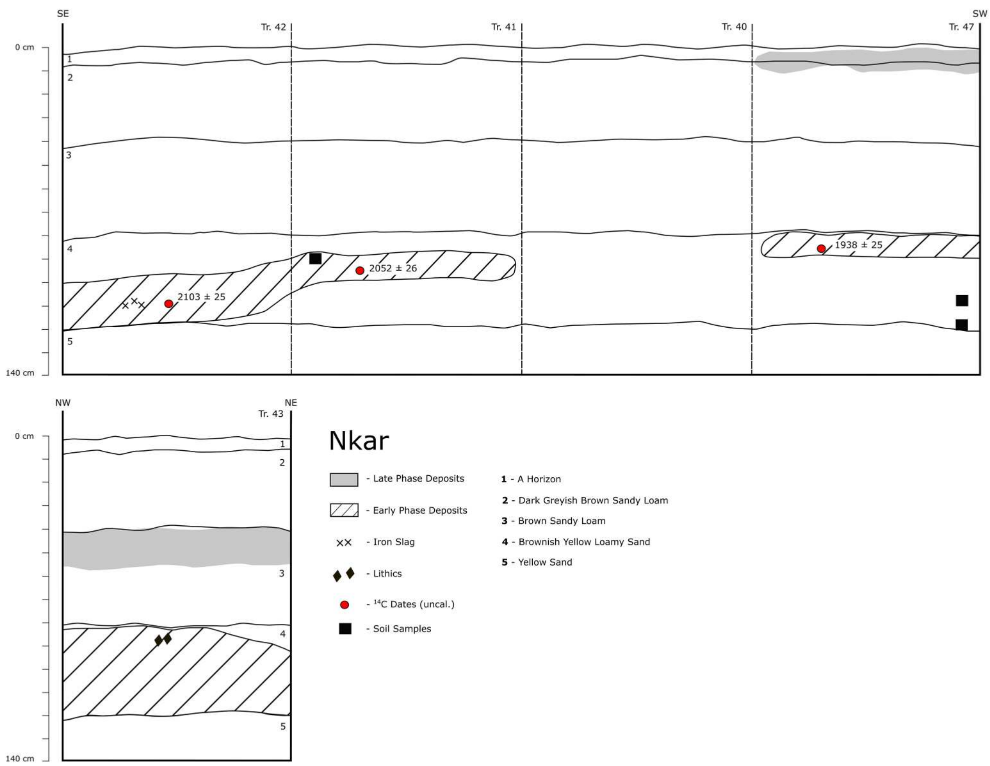

Figure 4. Stratigraphy of Nkar Tr. 40–47 southern profiles and Tr. 43 northern profile with Early Phase deposits (hashed polygons), Late Phase deposits (grey polygons) and the locations of soil samples (squares), iron slag (x) lithic artefacts (diamonds) and dated wood charcoal samples (circles).

Okwon

Okwon is located along the centre of the massif to the east of the modern village of Musanga and south of Nkar. The area is dominated by tall grass and agricultural fields with palm and mango trees interspersed. Pedestrian survey revealed numerous ceramic scatters over an area ~200 m in diameter. To capture the spatial extent of the subsurface deposits, a series of 1 × 1 m units was excavated across the area on an east-west transect (Figure 5d). In three instances, these test units yielded substantial subsurface material below the 40–60 cm sterile horizon, for which additional conjoined units were then established (Figure 5a–c). Eighteen units were excavated at Okwon, all but one of which produced cultural material.

As with Nkar, the early horizons at Okwon produced early pottery, lithic artefacts and iron slag. To test any association between these artefacts, the artificial depth of the excavation spits was reduced to 10 cm for all units after Tr. 10 (i.e. Tr 11–18). This is significant, as it has also allowed for a more refined stratigraphic resolution for defining the relationship between the Early Phase deposits and the radiocarbon dates. Interestingly, in addition to pottery, Okwon Tr. 11 (1977 ± 26 BP; RICH-27765) contained both lithic material and iron slag (Figure 6). The apparent stratigraphic integrity of the Idiofa sites implies that this represents a contemporaneous use of these technologies over the earliest periods of occupation. In addition to cultural material, soil samples were taken from the archaeologically sterile Tr. 7 to provide a background for archaeobotanical, palaeoecological and soil isotope analyses unaltered by anthropogenic deposits. The unit was excavated to a depth of 3 m and samples were taken from the western profile every 20 cm.

Isem

Isem is located in a vast, flat area on the same massif as Okwon, but at a slightly lower elevation. As with Okwon, the landscape was dominated by grass, but contained few

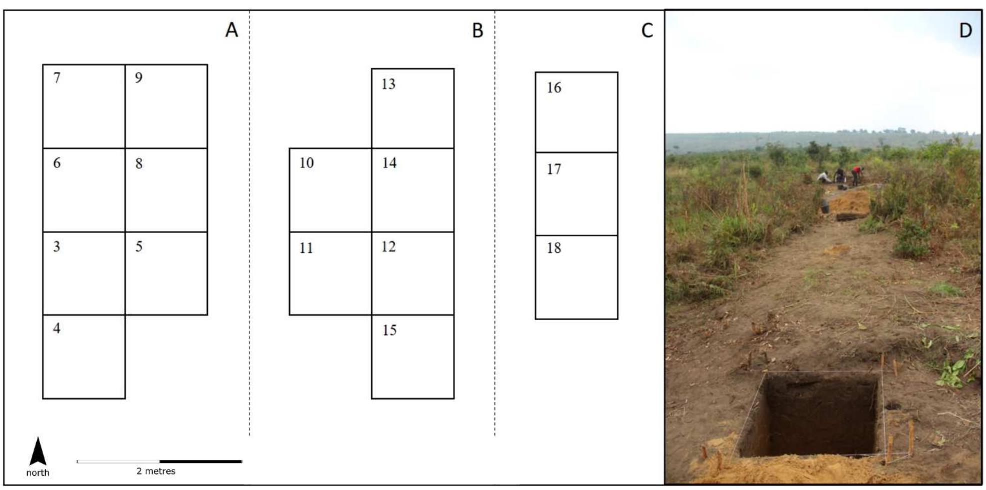

Figure 5. a–c) schematic of the excavation unit clusters at Okwon; d) photograph of Okwon Tr. 1–3 facing east.

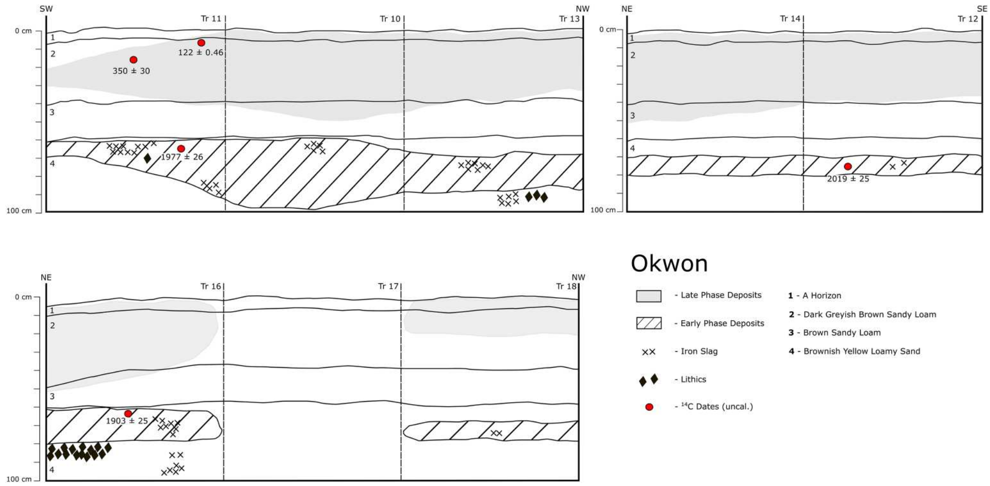

Figure 6. Stratigraphy of Okwon Tr. 16–18 northern profiles, Tr. 10–11 and 13 western profiles, and Tr. 12 and 14 eastern profiles with Early Phase deposits (hashed polygons), Late Phase deposits (grey polygons) and locations of soil samples (squares), iron slag (x) lithic artefacts (diamonds) and dated wood charcoal samples (circles).

trees (*olún*, *Milicia excelsa*) or bushes. The area is still periodically used to grow groundnuts and/or beans. Given the extent of the landscape, eleven individual excavation units (Tr. 19–29) were established along four 100-m-long axes oriented by the cardinal directions, two north-south and two east-west. These axes were laid out in a 'step' alignment, with the northern extent of the first (north-south) axis being the western extent of the second (east-west) axis, then the eastern extent of the second axis being the southern extent of the third (north-south) axis and the northern extent of the third axis was the western extent of the fourth (east-west) axis. This alignment was designed to capture two cross-sections of the massif's natural stratigraphy while intersecting several visible surface pottery concentrations. The stratigraphy in all the trenches (Figure 7) is composed of a humus layer followed by a light grey or brown soil layer and finally a yellow sandy-clay layer. No rubbish pits or other features were encountered during excavations. All trenches were excavated to 120 cm and while most of the material found was concentrated between the surface and a depth of 40 cm, several units (Tr. 21–22, 26 and 28–29) yielded pottery and lithic artefacts between 60 and 100 cm below the surface. Overall, however, Isem produced little material when compared to either Okwon or Nkar.

Ingung Kapia and Esal

Both Ingung Kapia and Esal were smaller-scale excavations than Okwon or Nkar and each only produced the more recent material found in the upper horizons. The site of Esal was located immediately to the south of Musanga village. Here, five (1 × 1 m) units were excavated to a depth of 100 cm. While the cultural material was concentrated in the upper 30 cm of each of these units, the dark sandy loam horizon continued for the entirety of the section. As such, no earlier material was recovered from any of the

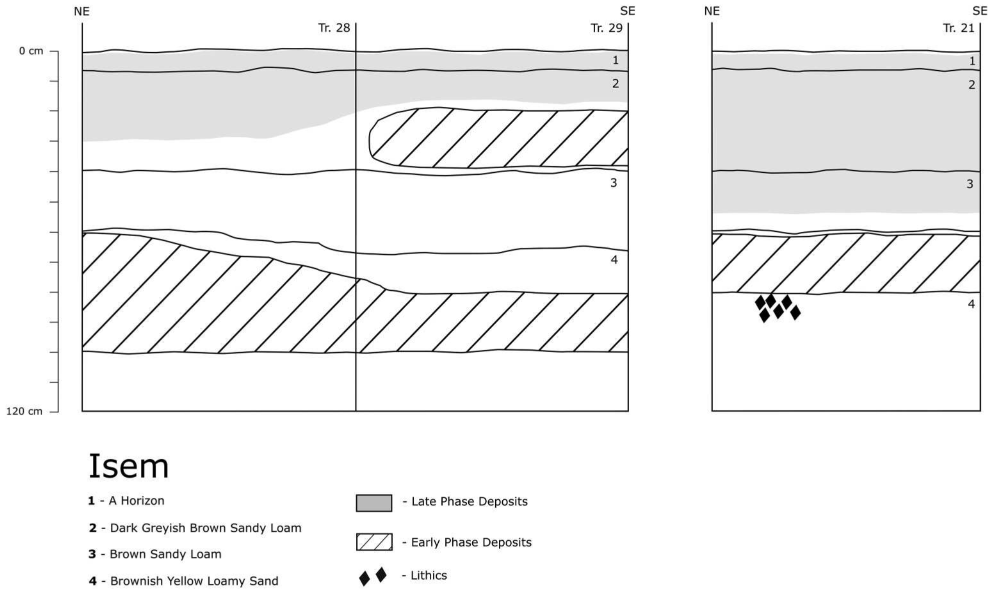

Figure 7. Stratigraphy of Isem Tr. 28–29 and Tr. 21 eastern profiles with Early Phase deposits (hashed polygons), Late Phase deposits (grey polygons) and the locations of lithic artefacts (diamonds).

excavation units here. In addition, Esal was the only example of more recent material being recovered in association with iron slag.

On the northwestern edge of Idiofa, the site of Ingung Kapia is located along a vast massif extension near the modern village of the same name. Through a combination of pedestrian survey and auger testing, two locations with significant concentrations of surface ceramics were selected for the installation of four units (1 × 2 m). Units 1 and 2 were excavated to a depth of 1 m and only produced a small amount of recent material between 0 and 60 cm. The conjoined units 3 and 4, however, yielded several objects, including human remains, fragments of raffia fabric, circular glass beads of several colours, iron and copper objects (bracelet and chains) and several clay pipe bowls. As human remains were recovered, excavations were called off by local leaders and the team was only permitted to retain the pottery. Despite this, the excavations at Ingung Kapia and Esal reveal the vast spatial extent of the latter occupation of the Idiofa region. From Okwon, Esal is approximately 2 km to the west and Ingung Kapia more than 15 km to the north.

Ceramic chronology

Post-fieldwork analysis of the cultural material was conducted in Kinshasa between March and April 2022. No complete vessels were recovered and thus all the ceramic results are based on fragmented pottery sherds. As this was the first modern archaeological project in the region, the main objectives included establishing an anchoring sequence of pottery form and style. Thus, the ceramic material was divided into 'mutually exclusive attribute groups,' including rim, decorated, special (e.g. lids) and non-diagnostic sherds (McIntosh and Guèye 2016: 123). All non-diagnostic sherds were counted, weighed and set aside. For all rim, decorated and special sherds, thickness, type and position of decoration, surface Munsell colour and paste coarseness were recorded. The latter was recorded using the Udden-Wentworth granulometric scale (Druc 2015), whereby three main categories were defined: fine (few to no inclusions), medium (grain sizes between 0.5 and 2 mm) and coarse (grain sizes of 1.5–4.0 mm). An additional diameter measurement was also taken for all rim sherds. However, while all sherds were counted, measurements and décors from any series of sherds that were successfully refit were only counted once to avoid 'insofar as possible' their over-representation in any given measurement (McIntosh and Guèye 2016: 123)

From the analysis of 3289 excavated sherds, three distinct pottery traditions were identified. However, while both Early and Late Phase material was recovered in substantial quantities, the 'Middle Phase' is represented by a meagre three sherds from Esal Tr. 30 and Okwon Tr. 5, with only one sherd being diagnostic (Figure 8i). A full and statistically meaningful analysis was therefore impossible and the 'Middle Phase' remains more theoretical than concrete, although it is decidedly distinct from either the preceding or following phases and comes from a horizon dated from two separate sites to between cal. AD 690 and 989. Nevertheless, because of the limited 'Middle Phase' sample size, the results below focus on the Early and Late Phases of the Idiofa pottery assemblage.

Early Phase assemblage (c. 146 cal. BC – cal. AD 226)

The Early Phase pottery assemblage at Idiofa was recovered exclusively from the yellowish loamy sand and upper portions of the yellow sand horizons found generally below 60 cm. While this early material is a comparatively small portion (N = 264) of the total assemblage, with 56 sherds present per cubic metre, elements were recovered from a high proportion of units at Okwon, Nkar and Isem. However, no early material was collected from units in either Ingung Kapia or Esal. While the pottery is distinct, it somewhat superficially resembles the slightly later Kay Ladio material (Figure 8j) found within the Kongo-Central province of Congo-Kinshasa and across the Congo River in Congo-Brazzaville (Clist *et al.* 2019a).

Surface colours largely range between light red (10R 7/8) to yellowish red (5YR 5/8), however several incidences of reddish brown (5YR 5/4) and grey (7.5YR 5/1) were also encountered. The paste is quite coarse and porous, with a low density of large (~5 mm) inclusions and voids (~3 mm) throughout the matrix. While the latter likely a result of organic temper, the inclusions appear to be a combination of undifferentiated stone and grog. Surprisingly, then, the pottery is quite thin, with a mean wall thickness of 6.9 ± 1.60 mm. The fabric of the pottery is uniformly consistent with the outer surfaces (i.e. Type 1 in Clist (2005)).

Decorative treatments are few and present on only ~11% of the total assemblage, possibly reflecting a preference for décor on the upper body of the vessels, including the shoulder, neck and rim. What décors there were, were dominated by thick (~2 mm) dragged-comb incisions with a 'U'-shaped profile (Figure 8a–g). These incisions are relatively shallow and almost exclusively arranged in parallel and linear patterns of more than 8 rows, although no complete vessels were recovered to establish a maximum count. While it is possible that these are the result of a wide-toothed comb, several examples displayed an irregularity consistent with a single instrument being repeatedly

Figure 8. Representative Idiofa Early and Middle pottery assemblage and potential analogues: a–h) examples of Early Phase Idiofa pottery; i) Idiofa Middle Phase; j) Kay Ladio Group pottery from Sakuzi; k) potential cord-wrapped Idiofa Early Phase pottery.

dragged across the surface, and it is thus likely that a combination of methods was used. In most instances, these groups of rows intersected with other groups at approximate 90° angles, producing a criss-crossed motif. Outside of this incision motif, only one example of a different décor was recovered from Okwon (Tr. 13). This sherd displays what appears to be a series of roulette impressions, which produced linear bands of depressions reminiscent of cord-wrapped roulette impressions (Figure 8k).

As with décor, vessel forms were also relatively homogeneous, i.e. exclusively restricted to either a 'simple' closed or slightly everted rim. Vessels were also quite small, with diameters ranging between 6 and 10.5 cm (mean of 8.38 cm), placing them in the 'pot' category of Clist *et al.* (2019b). In addition, these vessels were flat-bottomed, as evidenced by three base sherds recovered from both Okwon (Tr 5 and 11) and Nkar (Tr 41). This is in line with Wotzka's (1995) initial observation that, contrary to later periods, flat-based vessels are 'omnipresent' throughout the Inner Congo Basin throughout the EIA.

Late Phase assemblage (c. cal. AD 1487–1648)

Late Phase Idiofa material was recovered from within the dark sandy loam horizon generally positioned in the upper 40 or 60 cm of most of the excavation units. It has been identified from nearly all units at Okwon, Nkar, Isem, Esal and Ingung Kapia (exceptions include: Okwon Tr3 and 6; Nkar Tr 41, 42 and 45). In addition to this near ubiquity, Late Phase material was found in large quantities (N = 3025), with ~201 sherds m^{-3}, making up nearly 90% of the total pottery recovered during excavations. The breadth and quantity of the Late Phase cultural deposits suggests a significantly larger occupation when compared to the previous phase (i.e. 201 versus 56 sherds per cubic metre).

Surface colours were generally dark grey (5YR 4/1) with a sizable minority being light red (2.5YR 6/8) or yellow (10YR 7/6). The thickness of Late Phase material ranged between 2.7 and 10 mm; however, the mean was only slightly thinner than the previous phase at 5.4 ± 1.94 mm. The paste was generally classified as fine, with few to no inclusions. Likely highly fired, many of the sherds produce the 'high-pitched clinking' when tapped together (MacDonald 2011: 64). The majority of Late Phase sherds contained a darker core, Clist's (2005) Types 2 and 3.

Nearly all the vessels from which a form was successfully reconstructed were carinated with everted rims (Figure 9). Two round bases were recovered from Ingung Kapia (Tr. 3 and 4) and remain the only evidence we have for the base shape of Late Phase vessels. However, if taken as representative, these bases (as with the flat bases of the previous phase) fit well within the general transition from flat to round seen across the Congo Basin (Wotzka 1995). The average diameter of 12.1 cm still falls within the 'pot' category as defined by Clist *et al.* (2019b). Although few (4%), a second class of everted-rim vessel were defined as bottles based on elongated restricted necks (Figure 9f). The pervasiveness of everted rims may also account for the high number of lid fragments recovered. These lids, which are ~16 cm in diameter, were concave discs with a central handle of two types — either a single protrusion or a protrusion pinched to create two finger holes on either side (Figure 9 g).

While decorated sherds only make up 9% of the assemblage, the diversity of décors is substantially greater than in the previous phase. Three major categories of plastic décor,

Figure 9. Representative Idiofa Late Assemblage Pottery: a) geometric pin incision; b) paintbrush on lip interior; c) geometric pin incision with poinçonnage; d) appliqué ledge with poinçonnage; e) paintbrush; f) cordons with poinçonnage on bottle; g) lid; h) geometric pin incision with poinçonnage.

including poinçonnage (Figure 9 h), 'pin' incision (linear and geometric) (Figure 9a, c–d and h) and what we termed 'paintbrush' (Figure 9b, e) were common in the Late Phase assemblage. However, their use was found in various combinations and positions. Pin incisions appeared on ~40% of the decorated sherds, making it the most common décor. These are defined as thin and deep incisions, in rows of three to eleven, with an irregularity consistent with a single 'pin or thorn sized tool' used for each incision (McIntosh and Guèye 2016: 166). They appear in various positions and patterns, including linear bands on the neck, shoulder and/or lip, triangular geometric patterns on the shoulders, crosshatching on the concave side of lids and, less commonly, on the interior of an everted rim.

The décor next in popularity (31% of all decorated sherds) was 'paintbrush', likely the most distinctive identified. This décor was defined as the shallow imprint of a bundle of fibres — perhaps similar to a stiff-bristle paintbrush —dragged across the surface of the vessel in triangular and linear patterns, as well as wavy lines and zigzags. It can be found on any part of the vessel anatomy except for the base and lip, particularly the interior of the everted rims (Figure 9b). The poinçonnage (12% of all decorated sherds) was really formed by two distinct tools; one thicker and rounded and one thinner and sharp. The thicker examples are arranged in linear bands across the carination, through the top of the appliqué ledge (Figure 9d), or around the lip on the concave side of lids. The thinner 'tics' were created with the point of a sharp tool and are often found in geometric groups in combination with pin incisions or along the top of the lip. In smaller quantities there were also cordons (applied in bands around the neck of the vessel), appliqué ledges (applied to the carination), fingernail impressions (found below the ledge or carination) and perpendicular impressions with a straight edged instrument along the carination. Despite the variety of decorative treatments, the Late Phase assemblage was relatively homogenous and cohered to a generally uniform style.

Iron metallurgy

Although excavations did not yield any iron artefacts, as previously mentioned small amounts of iron slag were recovered from a number of contexts at Idiofa (Table 2). Interestingly, the Late Phase contexts yielded extremely little evidence of iron production or use. Instead, the Early Phase horizons from multiple units at both Nkar and Okwon

Table 2. Iron slag recovered by unit. Depths are in cm below the surface.

Site	Unit	Depth (cm)	Weight (g)	Associated date
Okwon	10	60–80	32.0	
Okwon	11	60–80	549.0	1977 ± 26 BP
Okwon	11	80–100	67.7	
Okwon	12	70–80	21.0	2019 ± 25 BP
Okwon	13	70–80	101.0	
Okwon	13	90–100	48.3	
Okwon	14	70–80	241.0	
Okwon	16	60–70	65.0	1903 ± 25 BP
Okwon	16	70–80	49.0	
Okwon	16	90–100	21.9	
Okwon	18	70–80	0.5 Tuyère	
Nkar	42	100–120	7.0	2103 ± 25 BP

provided nearly all of the ferrous material and one tuyère fragment (Okwon Tr. 18, 70–80 cm). The earliest context containing slag, located at Nkar Tr. 42 (100–120 cm), is dated between 146 and 18 cal. BC (2103 ± 25 BP; RICH-27769). This now represents the earliest evidence of iron production south of the Congo rainforest, nearly 200 years prior to the Kay Ladio tradition sites (30–475 AD) of Bu, Kindu and Mantsetsi etc. further to the west (Clist *et al.* 2019a).

It is important to note that no slag was recovered from the sediments above the Early Phase horizons — including the archaeologically sterile (40–60 cm) or Late Phase (0–40 cm) horizons — at either Nkar or Okwon. Furthermore, the oldest dated context at Nkar Tr. 42 (2103 ± 35 BP; RICH-27769) lacks any Late or Middle Phase material in the upper layers, significantly minimising the likelihood of mixed contexts or the downward migration of slag from later periods. A second date (2052 ± 26 BP; RICH-27767) from the upper portion of this context is in broad agreement, providing a high-level of confidence that the late second and early first century BC context from which the dates and slag were recovered were secure. As iron use is obviously known to have existed in the region during the fifteenth century AD, the general absence of slag in the more recent strata likely reflects a difference in site organisation, whereby smelting occurred in different locations, possibly outside the habitation zone. Only at the eastern site of Esal was slag recovered in association with Late Phase pottery, perhaps suggesting that during this period centres of iron production were located to the southwest of the areas investigated during this project.

Lithic artefacts

Few stone tools were also recovered from the earlier horizons, and thus only from Okwon, Nkar and Isem. Table 3 presents the technological inventory of these artefacts. The methodology for recording the techno-typological patterns of the artefacts (e.g. dorsal surface removals patterns, butt typology and measurements) followed Inizan *et al.* (1995). All the sites, despite the small size of the assemblage, maintain a homogeneous technology based on the exploitation of small blocks of local polymorphous sandstone (Petit 1990), a dominant rock in the regional Stone Age record. Except for a few pieces that could not be interpreted, all the artefacts echo one single reduction strategy, indicating both considerable homogeneity between the sites and the techno-cultural integrity of the deposits. In addition to this technological

Table 3. Techno-typological inventory of the lithic artefacts from Isem, Nkar and Okwon.

Artefact class	ISEM Tr. 21 80–100 cm	NKAR Tr. 43 80–100 cm	OKWON Tr. 11 60–80 cm	OKWON Tr. 16 80–100 cm	OKWON Tr. 13 90–100 cm	Total
Blade-like flakes	2					2
Cortical flakes				1		1
Elongated flakes	2	2		5	1	10
Flake fragments	1			1		2
Semi-cortical flakes					1	1
Short flakes				6		6
Used artefacts	1				1	2
Cores			1	2		3
Total	6	2	1	15	3	27

homogeneity, the artefacts present fresh ridges and their edges and metrical profiles are quite similar among the three assemblages with small-size flakes, although these do not qualify as microlithic (Figure 10; Table 4). The production straregy followed does not present clear typical characteristics of the local Later Stone Age technology (e.g. bipolar microlithic flaking, small-shaped tools, polished tools). Indeed, it is rather a 'side production' characterised by small size assemblages marked by a middle-size flake production turned toward obtention of parallel-sided short to elongated flakes thanks to uni- or bidirectional short reduction sequences and the use of the bipolar technique (Figure 10). No retouched pieces nor macro-use wears could be observed except for one small flake fragment from Isem and two pieces from Okwon (Figure 10a, d, g). These three pieces present a similar type of macro-usewear located on a thin, rectilinear cutting edge of rectangular-shape flakes. Further investigation could help to reveal whether these artefacts could have been used for similar types of activities. Besides the small size of the assemblage, the absence of debris and all *chaîne opératoire* elements seems to suggest off-site production.

Figure 10. Artefacts from sites in the Idiofa Region: a–c) Isem Tr. 21 80–100 cm; d and g) Okwon Tr. 16 80–100 cm; f) Nkar Tr. 43 80–100 cm. Artefacts a, d and f are small flakes displaying distal or proximal bifacial macro-usewear, artefacts b and c are blade- and bladelet-like flakes and artefacts f and e are flakes associated with bipolar knapping.

Table 4. Minimum, mean and maximal values of length, width and thickness of flakes from Isem, Nkar and Okwon, based on technological orientation.

Site	Number of flakes	Length (mm)			Width (mm)			Thickness (mm)		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum	Minimum	Mean	Maximum
Isem	6	21	35.7	60	12	21.0	29	12	7.2	29
Nkar	2	25	-	29	16	-	19	4	-	7
Okwon	16	14	32.3	73	12	27.5	27,5	3	8.9	19

Excavations at Okwon produced 19 lithic remains. Only one core was recovered from within the 60–80 cm spit. The blank is a small block of polymorphous sandstone. This core displays the pattern of three blade-like removals (length = 2x width). These removals have been produced by unidirectional flaking on an elongated and convex flaking surface thanks to a flat striking platform. This striking surface has been obtained as a result of one extended removal. However, no equivalent blade-like flakes are present in the overall assemblages despite the similar raw material. Rather, flakes from Okwon display attributes of unidirectional flaking from short flaking surfaces and five flakes from the 80–100 cm spit present scars of bipolar flaking with opposite bulbs and an impact point along the flaking axis on the ventral surface (Soriano *et al.* 2010). One atypical *pièce esquillée* (Brun-Ricalens 2006: 97) made of chert with crush wears on both the distal and proximal parts was also identified in Okwon Tr. 16 80–100 cm. In the same spit a core-fragment also in polymorphous sandstone was recovered, along with a thick flake showing peripheral unidirectional short removals ('square-shape' flakes) obtained by using the ventral surface of the flake blank as a striking platform.

At Isem, only six polymorphous sandstone flakes were recovered from the 80–100 cm spit in Tr. 21. These artefacts display consistent technical features including unidirectional elongated removals on their dorsal surface (except for one unreadable flake fragment). These dorsal patterns are associated with plain (N = 2) and linear butts (N = 2), although some butts are absent (N = 2). One flake fragment presents a distal bifacially crushed cutting edge suggesting a potential use. Finally, at Nkar, only two artefacts of polymorphous sandstone were recorded in the Tr.43 80–100 cm spit. Both feature similar technological patterns as Isem flakes and have been obtained via a bipolar technique.

Palaeoecology

With a view to providing a palaeoenvironmental context to the prelude to and duration of human occupation in the Idiofa region, soil samples taken from Okwon and Nkar were processed for $\delta^{13}C$ of soil organic carbon (SOC) and phytolith analysis (Table 5). The ratios of woody (C_3) and grassy (C_4) vegetation from soil organic matter, in combination with the proportions of grass, tree and palm phytoliths, provide complimentary methods of evaluating changing hyperlocal environmental conditions. Only a very limited amount of fragmentary charred macrobotanical evidence has thus far been recovered from Idiofa (a nut or fruit endocarp fragment from Nkar and a few as-yet unidentified grass rachillae from Okwon). Therefore, the combination of isotopic and phytolith evidence provides a crucial dataset that may shed light on changing past environmental conditions in the study area.

Table 5. Soil samples from Okwon and Nkar analysed for phytoliths and $\delta^{13}C$ of SOC.

			Counted phytoliths					Carbon isotope data			
Sample	Site	Depth (cm)	Grass	Tree	Palm	Other	Total	[C]	$\delta^{13}C$ (‰ v.s. V-PDB)	Grass fraction	Forest fraction
S06	Nkar Tr. 47	90–100						46.9%	-21.0	43.4%	56.6%
S08	Nkar Tr. 41	90–100	3	80	26	75	184	34.2%	-20.4	48.1%	51.9%
S07	Nkar Tr. 47	100–120	22	211	37	114	384	29.1%	-19.4	55.8%	44.2%
S50	Okwon	0–20						67.3%	-18.7	61.2%	38.8%
S02	Okwon	20–40	11	31	32	272	346	44.7%	-17.1	73.6%	26.4%
S05	Okwon	40–60	7	26	0	147	180	34.2%	-18.0	66.7%	33.3%
S04	Okwon	60–80	18	153	11	83	265	22.3%	-18.5	62.8%	37.2%
S21	Okwon	80–100	10	22	0	108	140	16.9%	-19.3	56.6%	43.4%
S03	Okwon	100–120	3	29	0	161	193	16.2%	-19.9	51.9%	48.1%
S22	Okwon	120–140	12	45	3	150	210	18.5%	-21.0	43.4%	56.6%
S01	Okwon	140–160						22.6%	-21.8	37.2%	62.8%
S23	Okwon	160–180						25.2%	-22.9	28.7%	71.3%
S47	Okwon	180–200						19.2%	-24.0	20.2%	79.8%
S48	Okwon	200–220						17.0%	-23.0	27.9%	72.1%
S24	Okwon	220–240	4	35	0	58	97	19.0%	-23.7	22.5%	77.5%
S49	Okwon	240–260	1	43	0	78	122	11.4%	-23.5	24.0%	76.0%
S51	Okwon	260–280						18.8%	-24.0	20.2%	79.8%
S52	Okwon	280–300						17.7%	-24.1	19.4%	80.6%

Carbon isotopes

Between 1 and 5 g of dried soil samples from Nkar (N = 3) and Okwon (N = 15) were analysed for $\delta^{13}C$ of SOC. The isotope analyses were performed using the elemental analyser EA-IsoLink coupled to a DELTA Q IRMS (Isotope Ratio Mass Spectrometer) via a ConFLo IV interface at the Isotope Bioscience Laboratory (ISOFYS), Ghent University. Reference materials of millet flour (USGS-90) and rice flour (USGS-91) (-13.75 ± 0.06 ‰ and -28.28 ± 0.08 ‰ v.s. V-PDB, respectively) were used to normalise to the V-PDB scale. A quality assurance soil sample (-22.69 ± 0.04 ‰ v.s. V-PDB) was introduced every ten samples; deviation from accepted values was always smaller than 0.3 ‰. Reproducibility was 0.4 ‰ and combined uncertainty on the V-PDB scale 0.5 ‰.

The relative proportion of soil organic carbon derived from grasses versus trees, or the grass fraction (fg), was computed, where fg = ($\delta^{13}C_S$ - $\delta^{13}C_f$)/ ($\delta^{13}C_g$ - $\delta^{13}C_f$) (Table 5). The endmembers for continuous woody and grass cover, C_f and C_g respectively, were taken from published topsoil values from modern savanna grassland and forest clumps on the Bateke Plateau (Ifo 2017).

The $\delta^{13}C$ data clearly show a general trend of decreased forest vegetation over time at Okwon, with notable contributions of C_4 vegetation not visible in the isotopic record until above 200 cm (Figure 11). All $\delta^{13}C$ values below 200 cm remain in the range of -24.1‰ to -23‰, suggestive of consistent dense forest before this time. Following the vegetation categories of White (1983), where trees make up >80% in forests, 40–80% in woodlands and 10–40% in wooded grasslands, we find that the computed forest fractions indicate a transition of forest to woodland at a depth of 200 to 100 cm. By the time

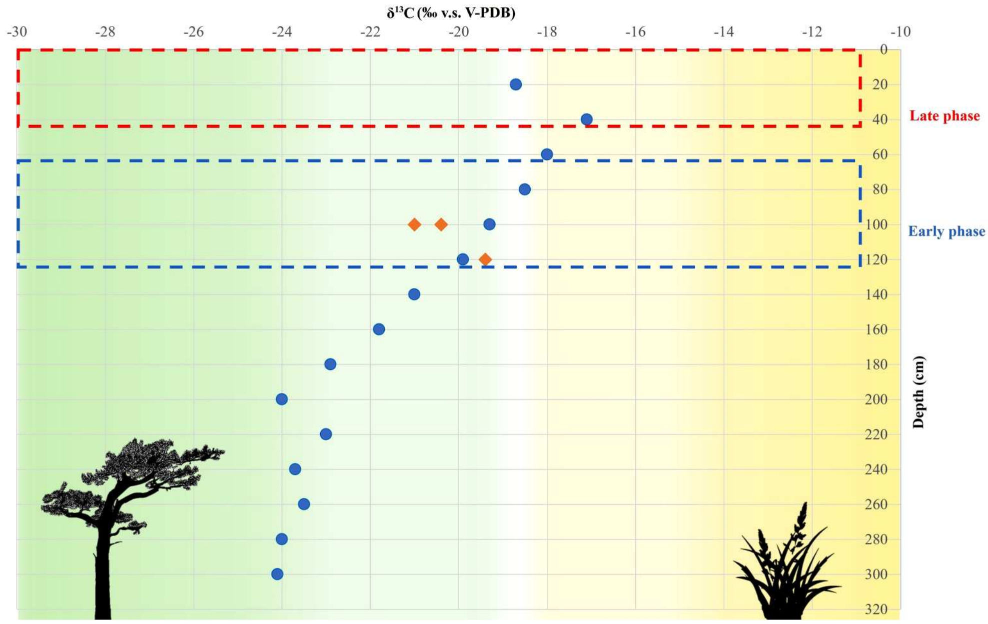

Figure 11. Variation in SOC $\delta^{13}C$ isotopic composition with soil depth at Okwon (blue circles) and Nkar (orange diamonds). The Early and Late phases of human occupation at Okwon are indicated by the dashed boxes.

of the Early Phase occupation at Okwon, the isotopic signature hints at a greater grass component in the area, although significant C_3 vegetation remained (37.2–48.1.8% forest fraction). Okwon and Nkar (44.2–56.6% forest fraction) show similar woodland vegetation contributions during the Early Phase. The greatest degree of $\delta^{13}C$ enrichment is seen at a depth of 20–40 cm, during the Late Phase occupation at Okwon (73.6% grass fraction, reminiscent of a wooded grassland). The apparent deviation towards more negative $\delta^{13}C$ values in the topmost layer is likely an artefact related to isotopic fractionation that enriches the SOC with $\delta^{13}C$ with soil depth (Balesdent and Mariotti 1996).

Phytoliths

Phytoliths were analysed from two samples at Nkar and eight samples from Okwon, including a continuous profile between 20 and 140 cm. The recovery protocol incorporated that of Piperno (2006). Organic material was removed from 15 g of dried sediment using H_20_2, followed by removal of carbonates using 10% HCl, then deflocculation with sodium diphosphate. Phytoliths were extracted via heavy liquid separation using sodium polytungstate. The resulting phytolith material was mounted on slides in Entellan New. At least 200 phytoliths were counted, where possible, and classified following Neumann *et al.* (2019). For the purposes of this study, phytoliths were classified into the broad groups of trees (woody dicots, mainly represented by spheroid ornate morphotypes), grasses (Poaceae, represented by grass silica short cell morphotypes), palms (Arecaceae, represented by spheroid echinate

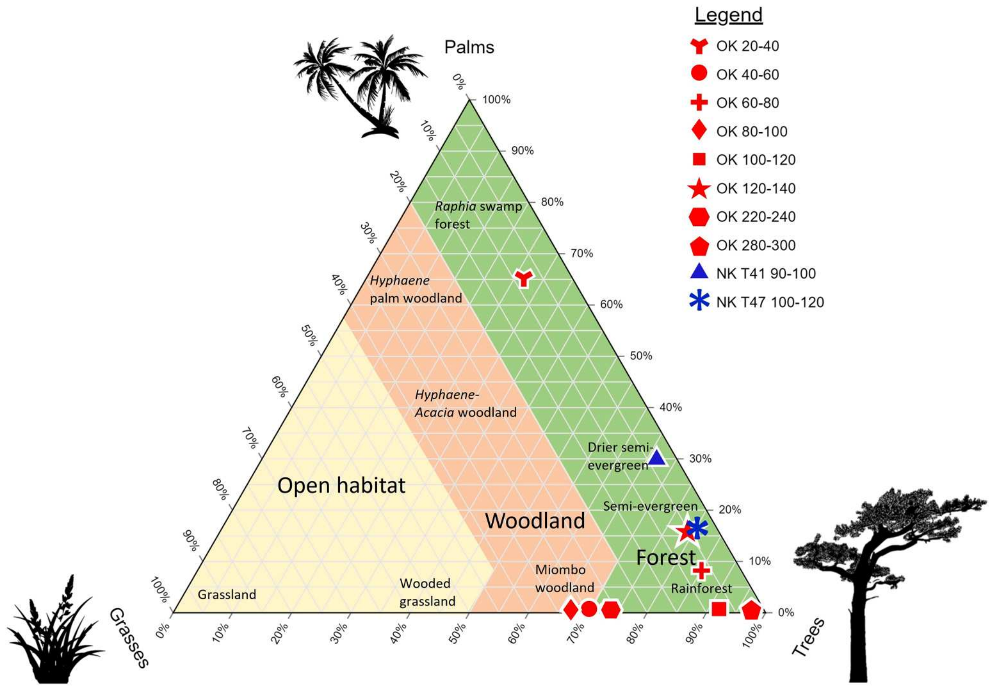

Figure 12. Ternary plot showing the relative proportions of palm, tree and grass phytoliths from soil samples taken at Okwon (OK) and Nkar (NK). The modern biome spaces were produced from published modern surface phytolith counts (Yost 2021: SOM Table S2). The figure was created with TernaryPlot.com.

morphotypes) and 'other'. Although not identified in detail at this time, the latter category included various morphotypes diagnostic of river weeds (Podostemaceae), sedges (Cyperaceae), squashes/gourds (Cucurbitaceae), the parenchyma of roots or tubers, an assorted 'herbaceous' component including representatives of the arrowroot family (Marantaceae) and non-diagnostic forms.

The relative abundances of palm, tree and grass phytoliths were calculated following Yost *et al.* (2021), as a means of evaluating the ecological space each site and level occupied (Figure 12). Temporal trends in relative phytolith proportions at Okwon are presented in Figure 13. The phytolith data broadly echo the forest signatures indicated by carbon isotopes at Nkar and Okwon but allow a more detailed look at the environmental composition. Tree phytoliths are continuously significant contributors to the assemblages, ranging in abundance between 35 and 75% of the total. Only in the lowest level at Okwon are tree phytoliths outnumbered by Marantaceae (arrowroot) phytoliths. Members of the Marantaceae are a common herbaceous understory component of closed-canopy forests in Congo-Kinshasa today (Mercader *et al.* 2000). During the Early Phase occupation, tree phytoliths make similar contributions at both sites, but palm trees are the more significant contributor of non-tree vegetation at Nkar, whereas grasses and herbaceous taxa make up a lot of that remaining proportion at Okwon. Palm phytoliths are represented by around 12–22% of the total phytolith counts at Nkar, compared to 0–5% at Okwon. This plots Okwon in a forest

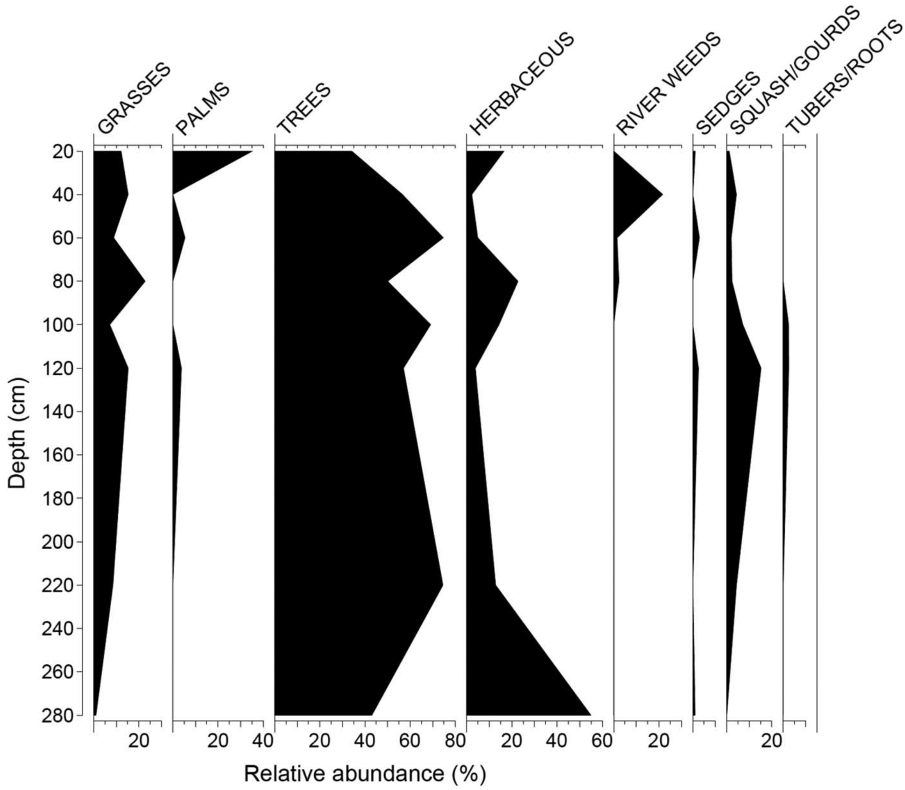

Figure 13. Phytolith spectrum diagram showing relative abundance of vegetation types throughout the soil column at Okwon, expressed as a percentage of all diagnostic phytoliths. The figure was created using Tilia 3.0.1.

setting with drier and more open woodland conditions at 80–100 cm and Nkar in a more semi-evergreen type forest with palm stands, such as might be seen in a riverine setting. The number of palm tree phytoliths at Okwon only shows a significant increase above 40 cm, during Late Phase occupation, rising to ~35% of the total vegetation profile. It is unsurprising that throughout the soil column palm, grass and sedge phytoliths are a rare component in the vegetative profiles, as all are shade-intolerant and usually absent from African forest understories (Pan *et al.* 2006; Bremond *et al.* 2017; Lombard 2022).

Scalloped spheres diagnostic of Cucurbitaceae and blocky and multiple-lobed parenchyma types originating from a root/tuber are found in the lowest samples analysed for phytoliths at Okwon. Sedges (Cyperaceae, represented by polyhedral phytoliths) have a small but consistent presence throughout the soil column, as do aquatic river weeds (Podostemaceae, represented by perforate or short irregular protrusion morphotypes), although these show an increase in abundance within the strata of the occupation hiatus between 40 and 60 cm. Finally, the herbaceous component consists of a variety of phytolith types including platelet, druse and seed-body types of flowering monocots, including those in the particularly well represented arrowroot (Marantaceae) family.

Discussion

The results of the BantuFirst archaeological and palaeoenvironmental analysis have significant implications for the history of both the Idiofa region specifically and Central Africa more broadly. For instance, the extent of past tree cover in the Congo Basin is of significant import to the discussion surrounding how and when early Bantu speakers passed through the equatorial forest block. In particular, evaluating the timing of shifts in the vegetative composition of the region may shed light on whether the Bantu Expansion was facilitated by climate-induced vegetation change (Schwartz 1992; Bostoen *et al.* 2015) or whether forest reduction was a response to human occupation and cultivation practices (Bayon *et al.* 2012; Garcin *et al.* 2018b). Both environmental proxies from Idiofa indicate a continued degree of tree cover throughout the soil column, but with a gradual $\delta^{13}C$ shift towards more open conditions that began prior to human occupation. This decrease in tree cover is in line with previous studies that indicate an aridification trend that saw the replacement of humid forest species with pioneer and savanna species in the late Holocene (Vincens *et al.* 1999; de Menocal *et al.* 2000; Neumann *et al.* 2012a). General and widespread forest destruction in Central Africa ~3000–2000 years ago has previously been suggested based on pollen records (Maley 2002), but more localised records such as the Idiofa dataset are of great importance if we are to extrapolate such changing conditions to human activities. Based on the current dataset, it is likely that the first pottery- and iron-producing communities in the Okwon and Nkar forests took advantage of a somewhat decreased density of trees but did not require open grassland environments to settle in these areas. The variation in forest types represented at Nkar and Okwon over time may instead allude to the development of more mosaic environments of mature and pioneer forests in response to increasing seasonality (Neumann *et al.* 2012a; Hubau *et al.* 2015; Bremond *et al.* 2017); future classification of the tree phytoliths from these sites may aid in clarification. Likewise, our data do not support the absence of forest in this region nor an intense erosional period, or 'Stone-Line event,' prior to 2000 BP (Runge 2001; Thiéblemont *et al.* 2013).

Thus, the environmental context of both the Early and Late Phase occupations at Idiofa was one of progressive forest contraction, beginning prior to the first settlers' arrival by the first century BC. Notwithstanding the ephemeral Middle Phase material collected from Okwon and Esal, both the stratigraphic interruption in cultural deposition and the acute differences between the pottery traditions suggest a hiatus in any substantial occupation of the region between the third and fifteenth centuries AD. At Idiofa, at least, it appears that this hiatus was not climate-induced. This pattern potentially fits with a trend seen across the Congo rainforest (Oslisly *et al.* 2013; de Saulieu *et al.* 2021; Seidensticker *et al.* 2021), whereby a population 'collapse' or restructuring may have led to fewer people or possibly the movement of people into new localities. In addition, based on the marked differences in vessel forms, size, recipe and decorative treatments, the two occupation phases at Idiofa clearly represent distinct populations rather than any continuation of the same cultural group.

Early Phase

Perhaps the most striking aspect of the Early Phase occupation is the presence of iron technology from within the earliest dated levels (*c.* 146–18 cal. BC). At present, this represents the earliest evidence for iron production south of the rainforest, nearly 200 years before the communities producing the Kay Ladio tradition pottery (*c.* AD 30–475) further to the west (Clist *et al.* 2019a). This is in stark contrast to the broadly contemporary non-iron-using communities associated with the Imbonga (*c.* 400–100 BC), Inganda (*c.* 200 BC—AD 100) and Monkoto (*c.* 100 BC – AD 200) pottery traditions to the north (Wotzka 1995; Seidensticker *et al.* 2021). Indeed, the earliest evidence for iron production from within the Inner Congo Basin comes during the Bondongo Phase (*c.* AD 1000–1400) (Wotzka 1995: 288). The presence of iron production at Idiofa in the second century BC is doubly interesting, as it is associated with both lithic and pottery technologies. While much of the lithic material was recovered from immediately below the Early Phase ceramics (i.e. Okwon Tr. 16), both lithic artefacts and ceramics were found in association at Nkar Tr. 43 and Okwon Tr. 11, with iron slag also found at the latter site. The homogeneity of the lithic assemblage suggests the continued use of this technology across the earliest periods of occupation. This, then, may represent the gradual adoption of — or increase in — iron smelting at the expense of lithic technology in the region towards the end of the first century BC.

Interestingly, for Idiofa, the closest iron-producing communities in time were also producing the closest analogues to the Early Phase pottery — the so-called Kay Ladio pottery tradition (Figure 14). While Kay Ladio is found more than 600 km to the west of Idiofa in the present-day Kongo-Central Province of Congo-Kinshasa and the adjacent

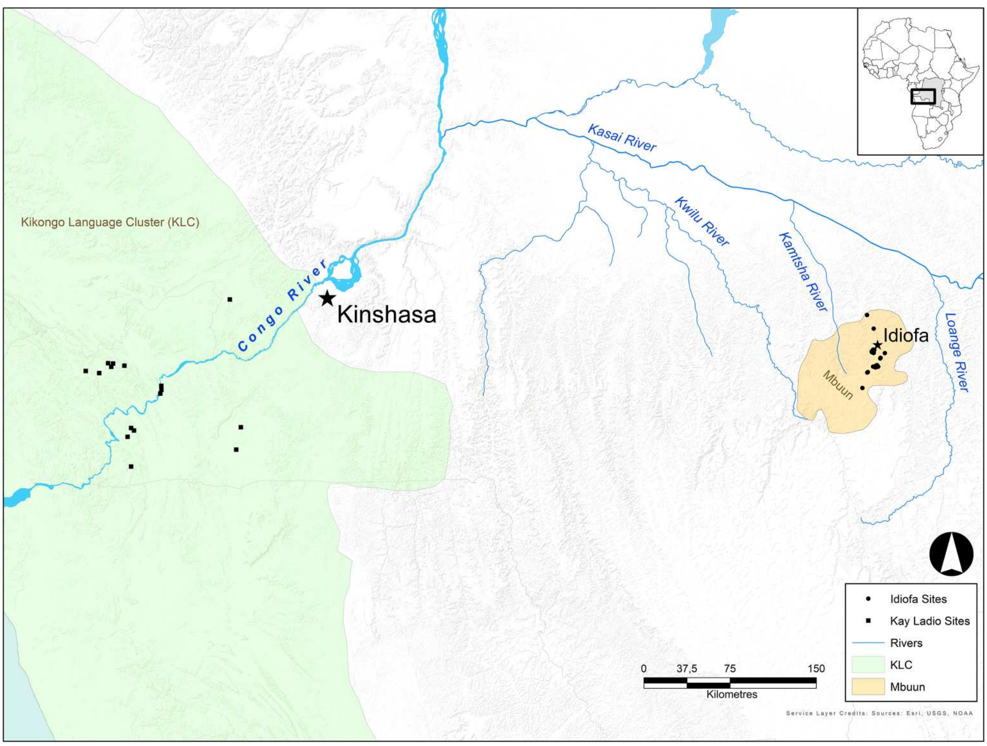

Figure 14. Regional map including the locations of the KLC (de Schryver *et al.* 2015) and Mbuun (Vansina 1966: 131) languages, Kay Ladio (Clist *et al.* 2019a) and the Idiofa sites.

region of Congo-Brazzaville, several elements — both decorative and morphological — link these two traditions (Clist 1982; Clist *et al.* 2019a). Both are defined by a limited set of closed (everted) vessels made of coarse paste with high numbers of large, irregular inclusions and voids. Decorative treatments for both Kay Ladio and Early Phase Idiofa are also dominated by thick horizontal, vertical and oblique dragged-comb incisions. For Kay Ladio, Clist (1982: 89) describes 'unités triangulaires dont le remplissage comprenait des traits obliques. Le sens du remplissage de ces unités s'oppose de l'une a l'autre et d'un bandeau à l'autre' ('triangular units with oblique lines in the filling. The direction of the filling of these units is opposite from one to the other and from one band to the other', our translation). Such decorative treatments are likewise found on numerous examples at Idiofa (Figure 8a–b, d–e).

These findings, along with additional forthcoming results from the BantuFirst research project, hint at the presence of a larger iron-using population to the east than is currently appreciated — and perhaps along the southern savanna region — during the first millennium BC. Based on possible connections with the later Kay Ladio material, it is likewise tempting to hypothesise an east-west movement of iron technology or iron-using peoples from the Lower Kasai region into the Lower Congo region around the turn of our era. However, any assumption of migration would require substantially more evidence beyond superficial similarities in pottery décor. Still, the presence of earlier iron production associated with pottery that shares some attributes with Kay Ladio does raise the possibility. Indeed, this scenario fits with the hypothesis of a 'northeast to southwest movement of peoples' previously proposed by Clist *et al.* (2019a: 19) based on the current inability to link Kay Ladio with earlier northern or northwestern traditions. Only further research, however, within the Kwilu and Kwango provinces and the regions between the more heavily researched Kongo-Central province will shed much-needed light on these processes.

Late Phase

Today, the region of Idiofa still maintains a substantial pottery production industry. At the village of Ingung Ateng, local informants explained that pottery produced locally is traded as far south as Gungu and as far north as Mangai, on the Kasai River. Interestingly, the 2021 BantuFirst survey along the Kasai and Kamtsha Rivers (Coutros *et al.* 2022) recovered Late Phase Idiofa material in varying quantities from sites including Intshwem Mukongo, Ivang, Ikulu and Eolo, locations more than 100 km away (Figure 15). Several examples appear to be more accurately defined as Idiofa-inspired, as they maintain Idiofa motifs — particularly the wavy 'paintbrush' incisions on the interior of the lip — but are executed on vessels made with radically different recipes than those found anywhere at Idiofa. Further, there are some examples where the wavy 'paintbrush' designs were made by a very different utensil (Figure 15a–d). Likewise, to the south near Gungu, the BantuFirst team recovered additional evidence for connections with Idiofa during recently revived excavations at the fifteenth- through seventeenth-century site of Mashita Mbanza (Coutros *et al.* 2023). While the full analysis of this material is ongoing, several sherds with Late Idiofa-type decorative motifs have been recovered, particularly the distinctive triangular 'pin' incisions combined with poinçonnage (Figure 15e).

Figure 15. Regional distribution of Late Phase Idiofa material: a) Eolo; b) Ivang; c) Ikulu; d) Intshwem Mukongo; e) Mashita Mbanza.

While the location of Idiofa near the headwaters of the Kamtsha River makes it a natural trade route with the communities residing along its banks, it is interesting that no later 'Idiofa ware' has been recovered from closer — and contemporary — sites along the Kwilu River (e.g. near Kikwit). Although the Late Phase Idiofa material does share some vague similarities with material collected from the contemporary sites within the Kikundi region (e.g. triangular incisions and everted vessels with poinçonnage or incised carination), the latter possesses a decidedly distinctive style and lacks the 'paintbrush' décor or any décor on the interior of the lip. Along the Kasai, Idiofa material was only recovered from sites at the Kamtsha-Kasai confluence and upriver and only along the left bank. The wide distribution of the distinctive Late Idiofa attributes throughout the fifteenth and seventeenth centuries AD suggests that the time depth of these connections is considerable. Of course, one must also contend with the possibility that Idiofa was not the centre of this trade network but is rather simply the most well studied site within it. Additional research within the region is essential to better define the modes of production and distribution. However, Idiofa's position at the geographic centre of the distribution zone — between Mashita Mbanza and the Kasai River, as defined by the BantuFirst surveys (Coutros *et al.* 2002, 2023) — and the ethnographic accounts of pottery production and exportation within the same space, provide evidence for the Idiofa region acting as a potential exporter of pottery — and possibly ideas or other goods — from at least the end of the fifteenth century AD.

Conclusion

Our archaeological investigations of the previously unexplored Idiofa region in the Kwilu province of Congo-Kinshasa have provided evidence for the oldest iron production so far known south of the Congo rainforest (*c.* 146–18 cal. BC). It is associated with both lithic artefacts and ceramics and is about two centuries older than the earliest documented iron production from the Lower Congo region some 600 km to the west, itself linked with Kay Ladio pottery (*c.* 30–475 AD). Palaeoenvironmental data from the Okwon and Nkar sites near Idiofa show that climate-induced forest contraction started well before those pottery- and iron-producing people colonised the region, even if it did not result in the total disappearance of forest. The newcomers certainly did not settle in open grassland environments but probably benefited from diminished forest density to immigrate. After their arrival, forest recession went on until modern times.

The ceramic production of the EIA around Idiofa is characterised by a small assortment of closed-rim vessels made with a coarse paste and decorated with thick horizontal, vertical and oblique dragged-comb incisions. Stylistically, the Early Phase pottery from around Idiofa (146 BC – AD 226) is, at present, most closely related to Kay Ladio pottery (AD 30–475) from the Lower Congo region, which is also associated with the earliest iron production there. This correspondence in pottery and iron production and the two-century time difference is by no means compelling evidence for an east-to-west migration of pottery- and iron-producing communities, but it is certainly a historical scenario that merits further archaeological investigation, particularly by multiplying excavations in intermediate regions. This is even more so, because historical linguistic evidence situates Idiofa at the extreme eastern end of an ancient east-to-west expansion of Bantu languages, i.e., the major branch of West-Coastal Bantu that gave rise to the Lower Congo region's Kikongo Language Cluster (Figure 14). New research should test whether the EIA record of the Idiofa and Lower Congo regions might indeed reflect the archaeological backdrop of an early expansion of West-Coastal Bantu speakers from their homeland region in the interior between the Kasai and Kamtsha Rivers towards the Atlantic coast.

In any event, the early occupation phase around Idiofa ends in the third century AD and is followed by a long stratigraphic interruption in cultural deposition that lasts until the fifteenth century, despite some short-lived 'middle phase' evidence collected from Okwon and Esal. Our palaeoclimatic data suggest that this hiatus was not conditioned by climate change. The Late Phase pottery (*c.* AD 1487–1648) that emerges afterwards is markedly distinct from the EIA pottery in vessel forms, size, recipe and decorative treatments. Thanks to other archaeological surveys of our team in the Kwilu province, we know that the paintbrush design typical of those LIA Idiofa ceramics is spread throughout the wider region, i.e. from the Kasai River in the north to Mashita Mbanza in the south but often executed with different tools and on vessels made with different recipes. It is absent, however, further west along both the Kasai and Kwilu Rivers where our team has also conducted surveys. It is also very distinct from the fifteenth- and seventeenth-century pottery that circulated in the Kongo kingdom in the Lower Congo region (Clist *et al.* 2018b). Hence, this LIA pottery from Idiofa seems to be indicative of a long-distance network of trade and possibly other types of exchange throughout the Kamtsha-Kasai River network ranging from Mashita Mbanza in the south to Eolo in the north. Interestingly, the Mbuun language currently spoken around Idiofa shows the deepest genealogical connections with the Kikongo Language Cluster, just like EIA pottery from Idiofa is most similar to EIA Kay Ladio pottery from the Lower Congo region. At the same time, as the result of more recent language contact, Mbuun language shares several salient sound changes with languages from the Kwilu-Kamtsha-Kasai River network spoken in its immediate vicinity but belonging to different deep branches within West-Coastal Bantu (e.g. Koni Muluwa and Bostoen 2012; Bostoen and Koni Muluwa 2014; Pacchiarotti and Bostoen 2021). The contact-induced spread of those phonological oddities may be the linguistic reflection of the fifteenth- through seventeenth-century exchange network manifested in the archaeological record of Idiofa and the broader Kamtsha-Kasai River network. More research is needed to better understand the cultural, social, political and/or economic processes driving these regional communication chains.

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