Using Radiocarbon Dates

Their Stratigraphic Context

Prepared by Bernard Clist

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and the British Institute in East Africa Partnership

PanAfrican
Archaeological
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List of sources used in the presentation

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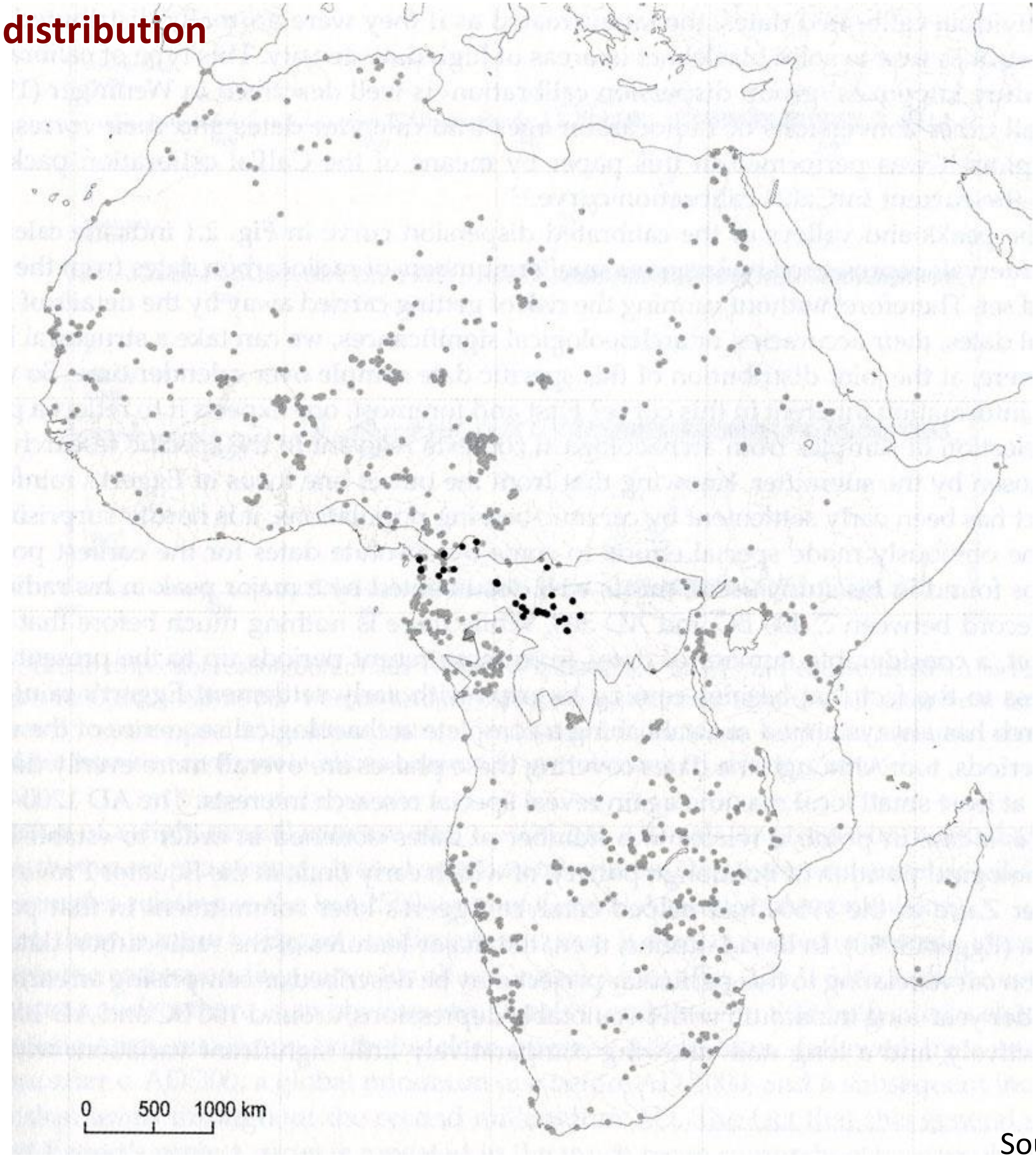
Map of African ^{14}C dates in 2006. Note their patchy and unequal geographical distribution



Source : Wotzka, 2006: 275, fig.1

Web resources

Dating principles:

Radiocarbon Dating Tutorial by David Killick, prepared for the Society for African Archaeologists' (SAfA) African Chronometric Dating Fund Committee, 2022.

Radiocarbon dating = https://c14.arch.ox.ac.uk/dating.html

Radiocarbon calibration = https://c14.arch.ox.ac.uk/calibration.html

Sample contamination and pretreatment = https://www.radiocarbon.com/carbon-dating-pretreatment.htm

Software to carry out 14C dates corrections:

http://calib.org/ = Calib v.8.2

https://c14.arch.ox.ac.uk/ = OxCal v.4.4

Radiocarbon dating Laboratories list:

https://radiocarbon.webhost.uits.arizona.edu/sites/default/files/Labs-2022_04_19.pdf

Dating errors may be the result of several factors: (1/2)

1. Variations over time in the level of radioactive carbon in the Earth's atmosphere (solution: calibration);
2. Variations in the rate of radiocarbon fixation in different wood species;
3. The nature of the dated sample with specific chemical characteristics (e.g., dates on bones or marine / mangrove shells);
4. The life span of the dated sample (e.g., variation in trees). Concept of the “old wood” effect;
5. Contamination of the sample with carbonates, humic acids and rootlets (solution: pre-treatment at the dating laboratory, thus use of the same lab known for its reliability, either commercial or institutional);
6. Incorrect handling in the dating laboratory (solution: use of the same lab known for its reliability, either commercial or institutional);
7. Underestimation of the standard error in the dating laboratory (solution: as 6.);
8. Dating laboratory peculiarities that create dating discrepancies for the same sample processed by two different laboratories (solution: as 6.);
9. Incorrect combination of dates from the same layer or archaeological site (solution: statistical methods and stratigraphic data to be used correctly) ;

Dating errors may be the result of several factors: (2/2)

10. Poor statistical analysis of an entire industry or culture (solution: statistical methods and graphic processing to be used correctly);

11. Use of the wrong dendrochronological correction tables (solution: use standard software, either Calib or OxCal which have the latest tables in their program);

12. Mixing of materials of different ages, especially for charcoal (solution: care of the sampling during fieldwork, see below);

13. Poor association between dated material and archaeological material to be dated, reference to the Degree of Certainty Association or DCA (solution: care of the sampling during fieldwork, see slides below):

    A: Full certainty. The archaeological object itself furnished the measured sample;
    B: High probability. There is a direct functional relationship between the organic material which is measured and the diagnostic archaeological finds;
    C: Probability. There is no demonstratable functional relation between measured sample and archaeological material, but the quantity and the size of the fragments argue in favor of a relationship;
    D: Reasonable possibility. As C, but the fragments are small and scattered;
    E: Possibility (added by P. de Maret 1978). As D, but the fragments come from the same depth as the archaeological material, in an unstratified deposit.

Source : Waterbolk 1971; de Maret 1978; Clist 1987.

Impact of radiocarbon dates calibration during the Holocene

Variations over time in the level of radioactive carbon in the Earth's atmosphere leads to periods where the result of a calibrated ^{14}C date is questionable.

Here, on the next slide, fictitious dates from part of the Holocene have been processed using the Calib program (dates by 50-year steps with a standard deviation of 50 years, calibration with the Northern Hemisphere tables).

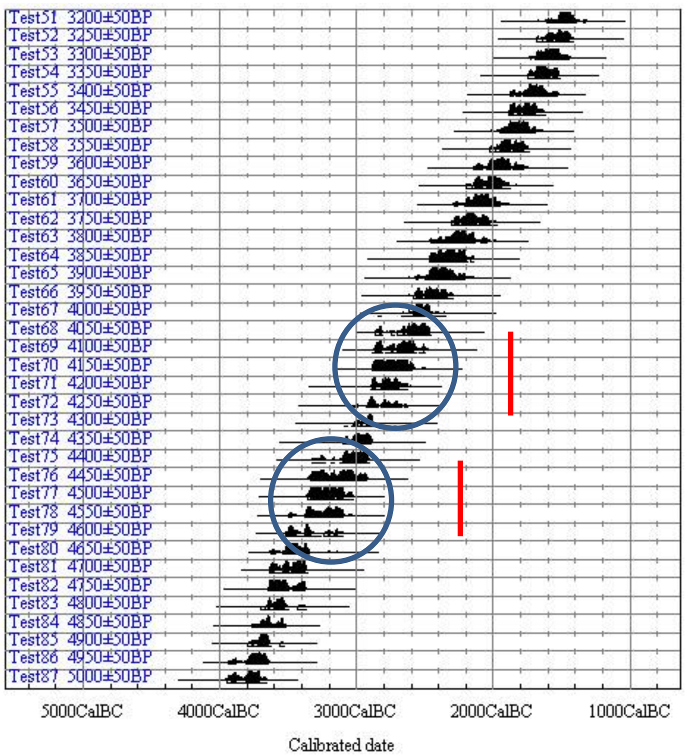
From 750 to 2150 bp the results are fairly regular. A shearing effect starts at 2150 bp and continues until 2,800 bp with several periods during which the corrected dates tend towards the same result. Two important steps exist between these periods, at 2300/2350 bp, and 2600/2650 bp. Also, the 2450/2550 bp period between these two steps sees the calibrated dates correspond to long intervals, hardly usable for an historical reconstruction. To sum up, the entire period from 2300 to 2650 bp will cause problems for archaeological reconstructions, unless they are supported by quality ceramic typologies.

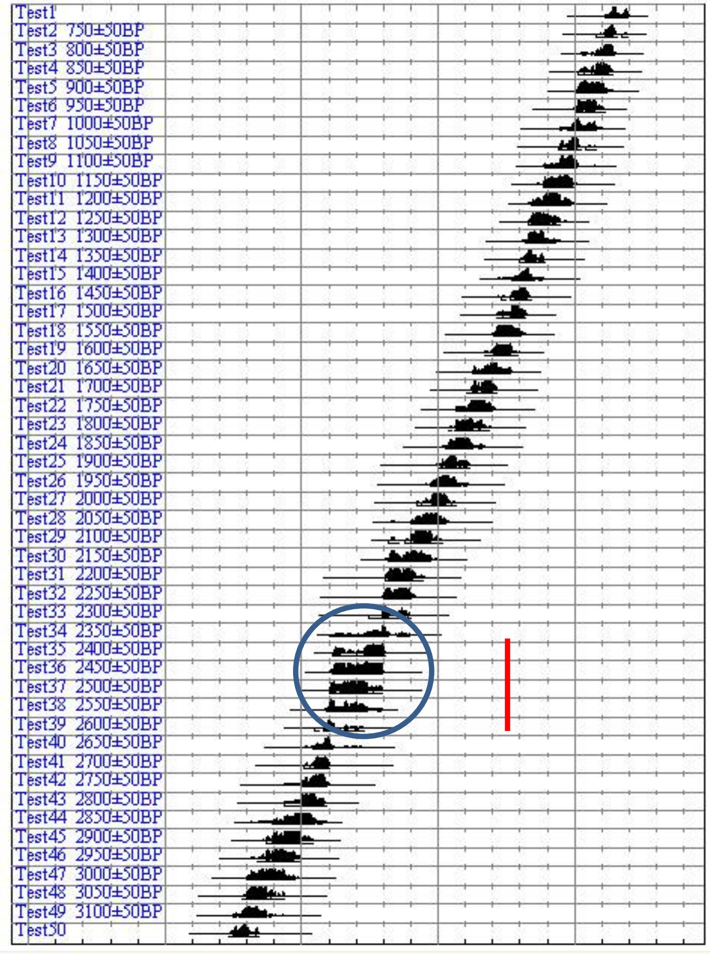
Earlier in the Holocene, between 4050 and 4250 bp and from 4400 to 4600 bp, the calibrated dates also provide very wide periods.

For historical archaeology (1650-1950), calibrated ^{14}C dates are of dubious use as their range is wide and often provide several periods where the event one wants to date can lie. If European artefacts are present, using their relative chronology provides a better marker (e.g., glass beads, Portuguese pottery, English and Dutch tobacco pipes). Nevertheless, the absence of such artefacts can lead one to date material like wood charcoal or palm nuts.

Impact of radiocarbon date calibration during the Holocene (2/2)

From 3200 to 5000 bp





From 750 to 3150 bp

« Hallstatt plateau »
2350 – 2600 bp

4050 – 4250 bp
&
4400 - 4600 bp

Source : Clist 2005: 136-137

Stratigraphic context – Case 1. An ideal case: horizontal layers

Source : Oxbow site, New Brunswick, Canada. Lower layers dated to c.3000 bp
https://www1.gnb.ca/0007/culture/heritage/vmc/display-image.asp?id=141

The artefacts and ecofacts are well located and isolated by successive layers of sand and silt deposited during spring freshets (melts). The correct association between the cultural material and the ^{14}C dates obtained is convincing.

Case 2A. A less ideal case: sub-horizontal layers almost well superimposed, but with some traces of vertical displacement

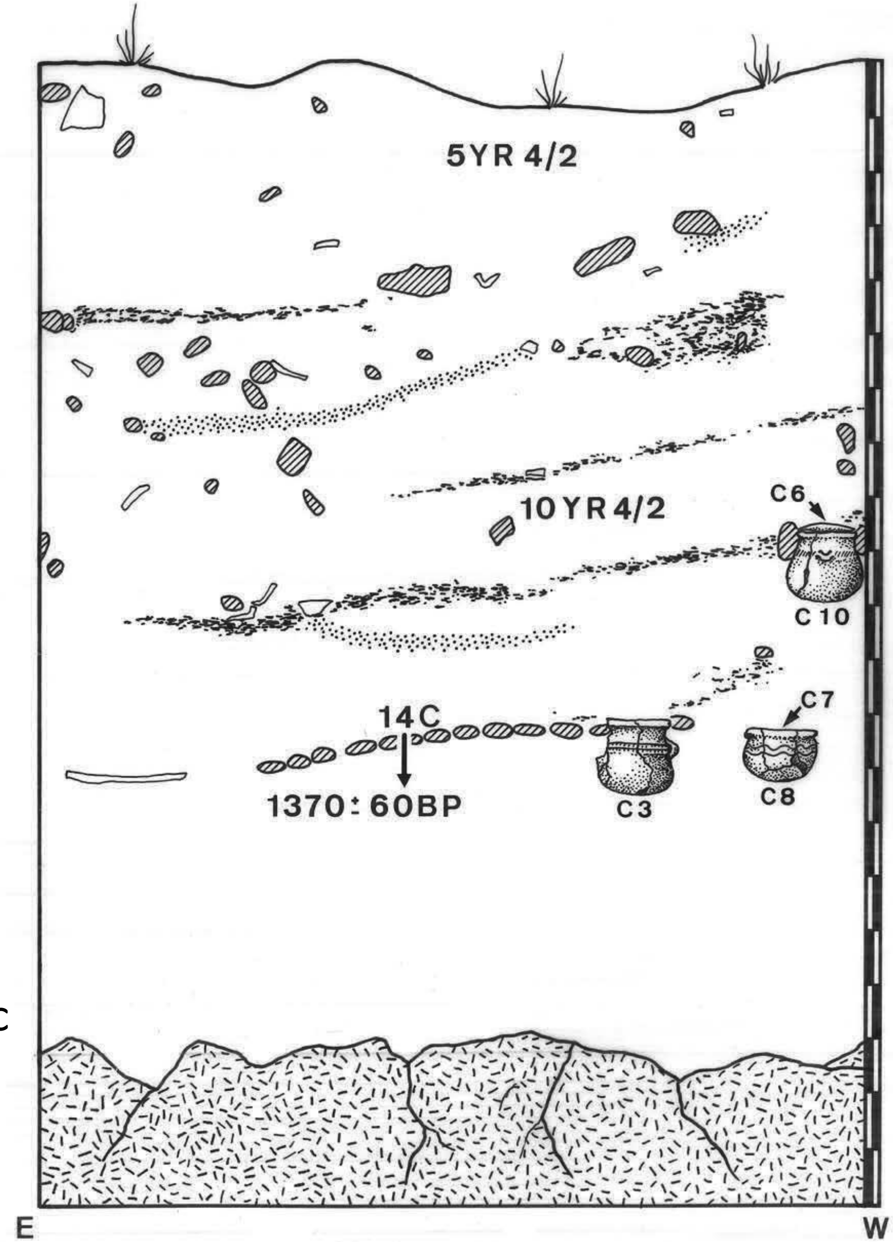
Profile of the Carboneras site, north coast of Bioko Island, Equatorial Guinea.

Illustration shows importance of potential discordance between the depths of natural stratigraphic vs. planimetric (5 or 10 cm arbitrary spits or levels) during excavation.

If the goal is to date a given artefact at a specific depth within a natural stratigraphic layer, and your dating sample comes from an arbitrary spit whose depth does not lie within that natural stratigraphic layer due to vertical displacement, you risk obtaining an incorrect date due to poor spatio-temporal association between the artefact and the dated sample.

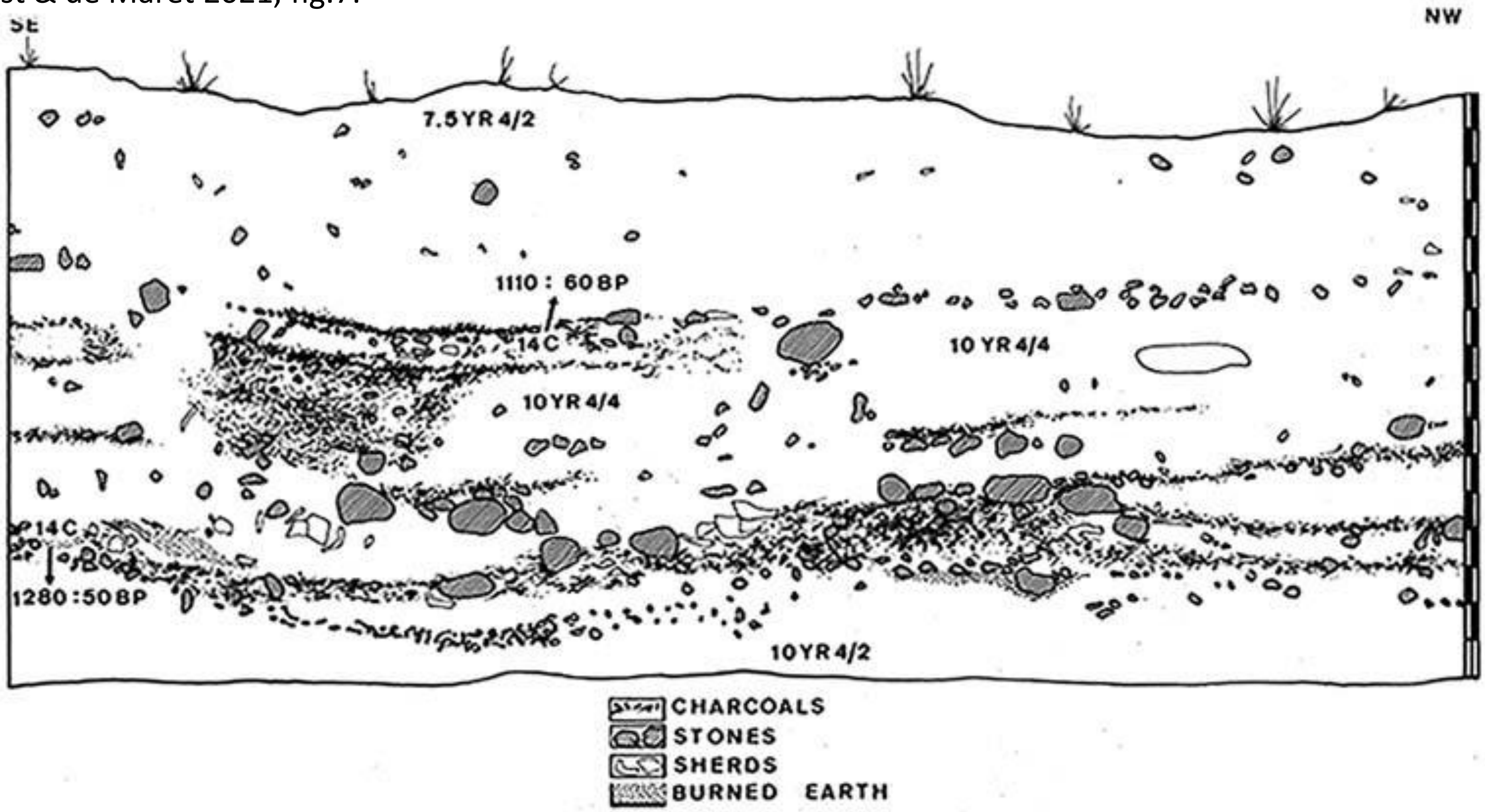
Comparing natural stratigraphic vs planimetric excavation levels is the best tool for avoiding such errors (see Slide 13).

Source: Clist & de Maret 2021, fig. 10.



Case 2B. A more complicated case: sub-horizontal layers with some traces of vertical displacement and possible mixing between layers

Profile of the Carboneras site, north coast of Bioko Island, Equatorial Guinea.
Another illustration the need to watch for potential differences between natural stratigraphic and planimetric recordings (see Slide 13) during excavation. The site was located overlooking the beach. This section shows the complexity of the deposits with possible stratigraphic mixing (compare with slide n°10).
Source: Clist & de Maret 2021, fig.7.



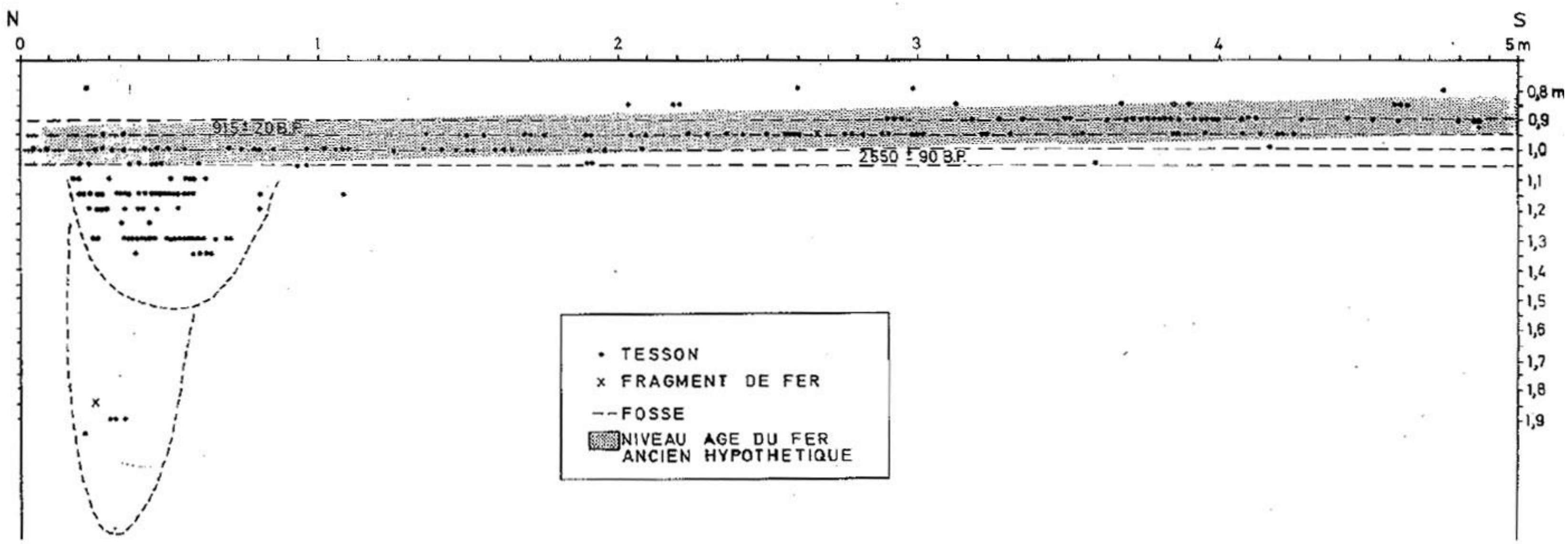
Case 2C. Sub-horizontal layers with evidence of vertical displacement and possible mixing because of a complex site history

Profile at Ngongo Mbata, a major economic hub of the Mbata province of the Kongo kingdom, late 16th – mid-18th century. In this sector, evidence of the priest's house (stone blocks near the surface), several tombs of a small external cemetery from the site's 17th century church, and a large early 17th century pit (center of picture) containing amongst various Portuguese-made objects, a very large fragment of a bronze bell.

Source: Clist et al. 2018: 81, fig. 10-17.

Case 3A. Possible bias due to excavation strategy

Sampling of wood charcoal to be dated collected by artificial spits of 5 cm or 10 cm thickness.



Gombe site, Kinshasa (DRC): position of archaeological material showing a slight tilting of the main deposit (highlighted in grey). This led to a possible mixture of materials from different periods within each spit (level), especially between Late Stone Age, Early Iron Age and Late Iron Age assemblages.

Source : Cahen et al. 1983: 450, fig.3.

Case 3B. Possible bias due to excavation strategy

Okala site (Gabon) : pit 13, excavation by artificial spits of 10 cm. This may not correspond to the history of the refuse pit filling which has 8 recorded episodes.

Source : Clist 2005: 333, fig.6-113 & 6-114.

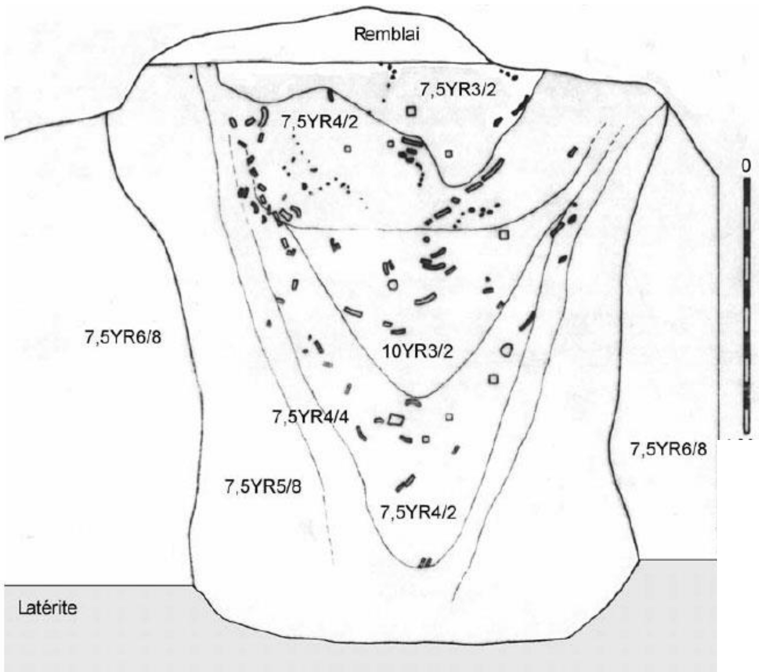


Figure 6-113 : coupe nord, structure XIII.

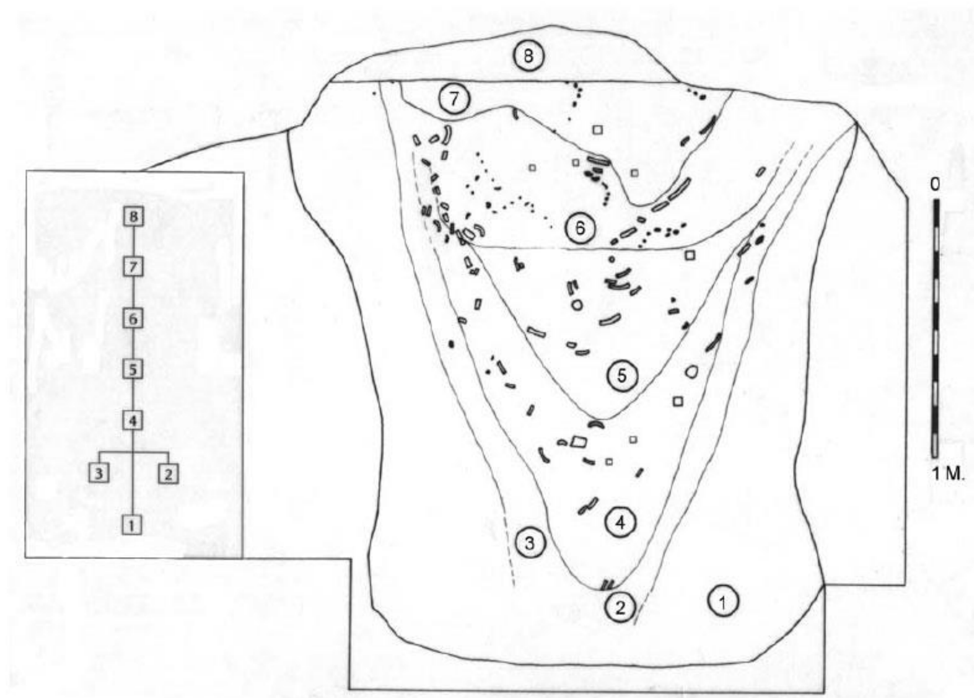
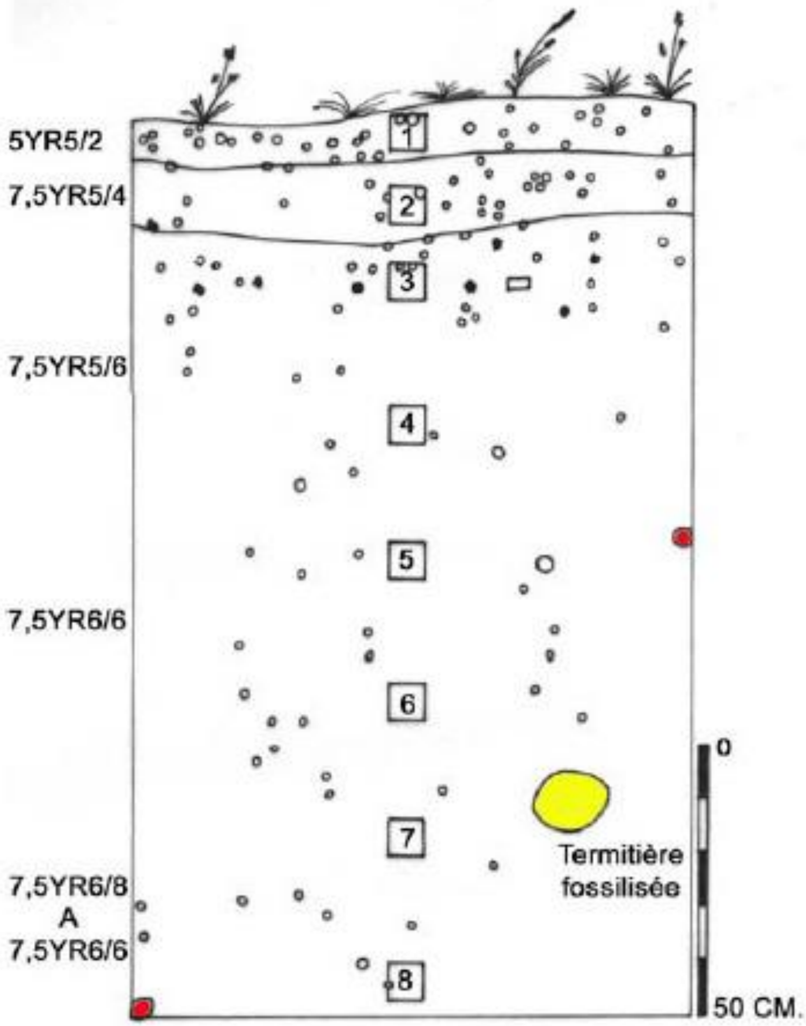


Figure 6-114 : reconstitution graphique du dépôt des couches de remplissage, structure XIII.

Case 4A. Possible bias due to post-depositional bioturbation

Presence of burrowing fauna, e.g., termites, ants, beetles, wasps, palmetto rats, at the time of the creation of the archaeological deposits and/or after their creation.



Ofoubou helipad site (Gabon): presence of termite mounds (yellow), and beetle galleries (red) down to 2 meters.

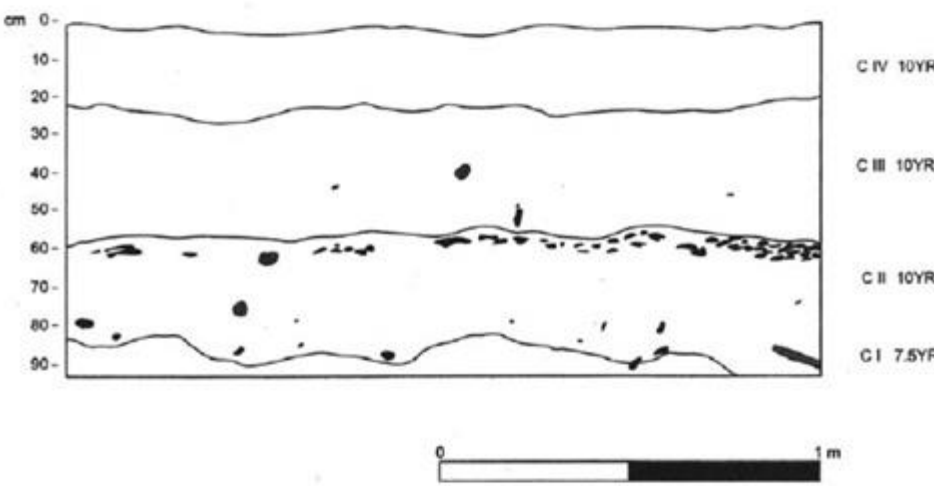
This may result in recent wood charcoal samples being collected, sometimes at great depth due to soil displacement by insect activity, including nest building, or from natural bush fires converting roots into charcoal.

Source : Clist 2005: 177, fig. 5-22.

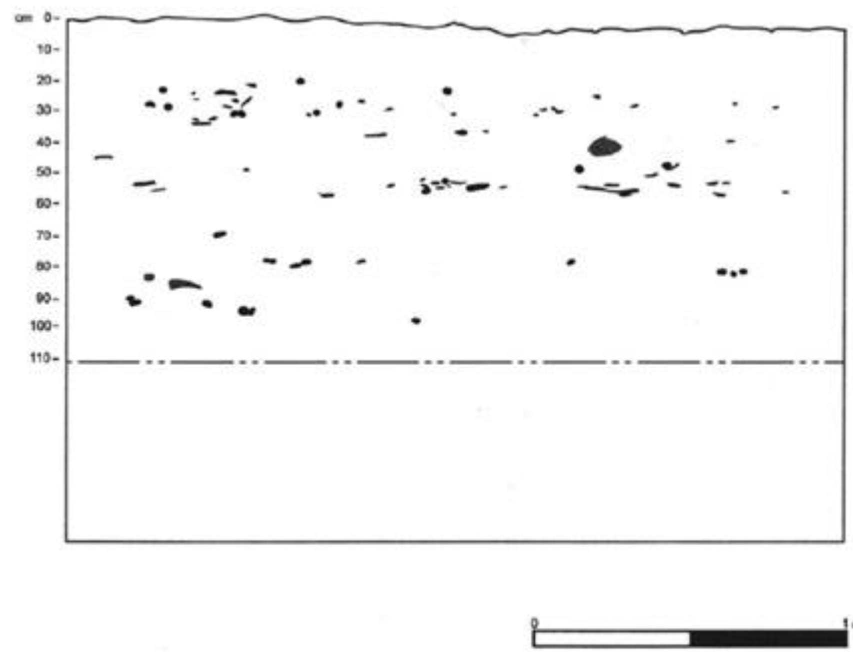
Case 4B. Possible bias due to post-depositional bioturbation

After the development of archaeological levels, burrowing fauna, e.g., termites, ants, beetles, wasps, palmetto rats, cane rats, etc., may move, mix and disperse artefacts and ecofacts throughout local soils. In the case below, it is mainly termites, according to a recent site reevaluation of the River Denis site in Gabon.

1. Archaeological deposit with limited evidence of bioturbation

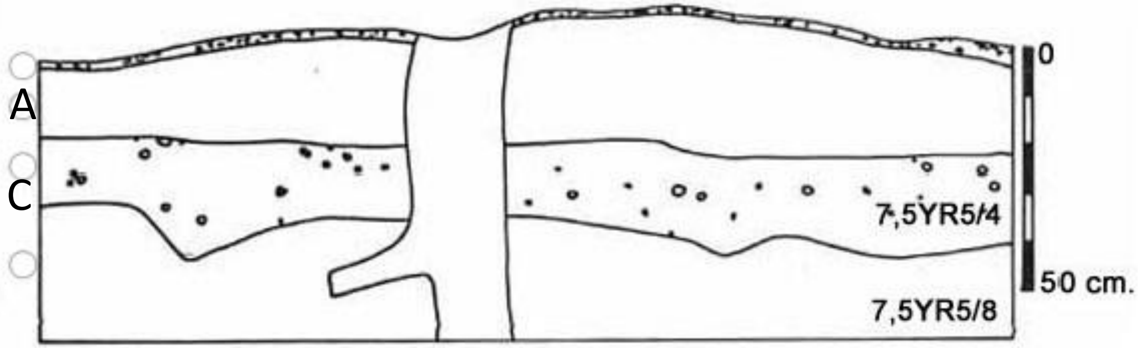


2. Archaeological deposit with extensive evidence of bioturbation

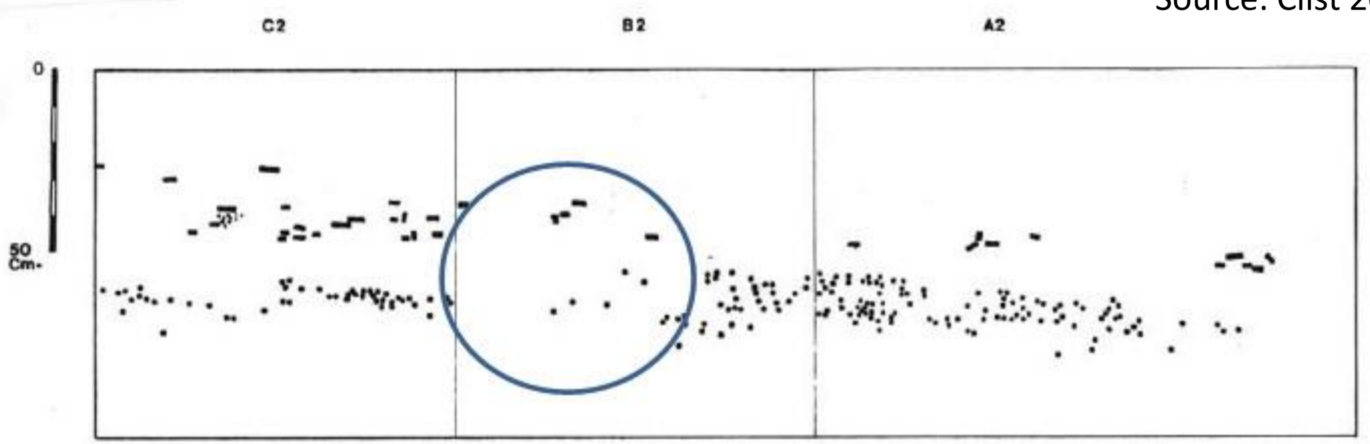


Source : Abboud 2002, figs. 12 & 13

Case 4C. Possible bias due to post-depositional botanical intrusion. Trees and roots cutting through archaeological deposits

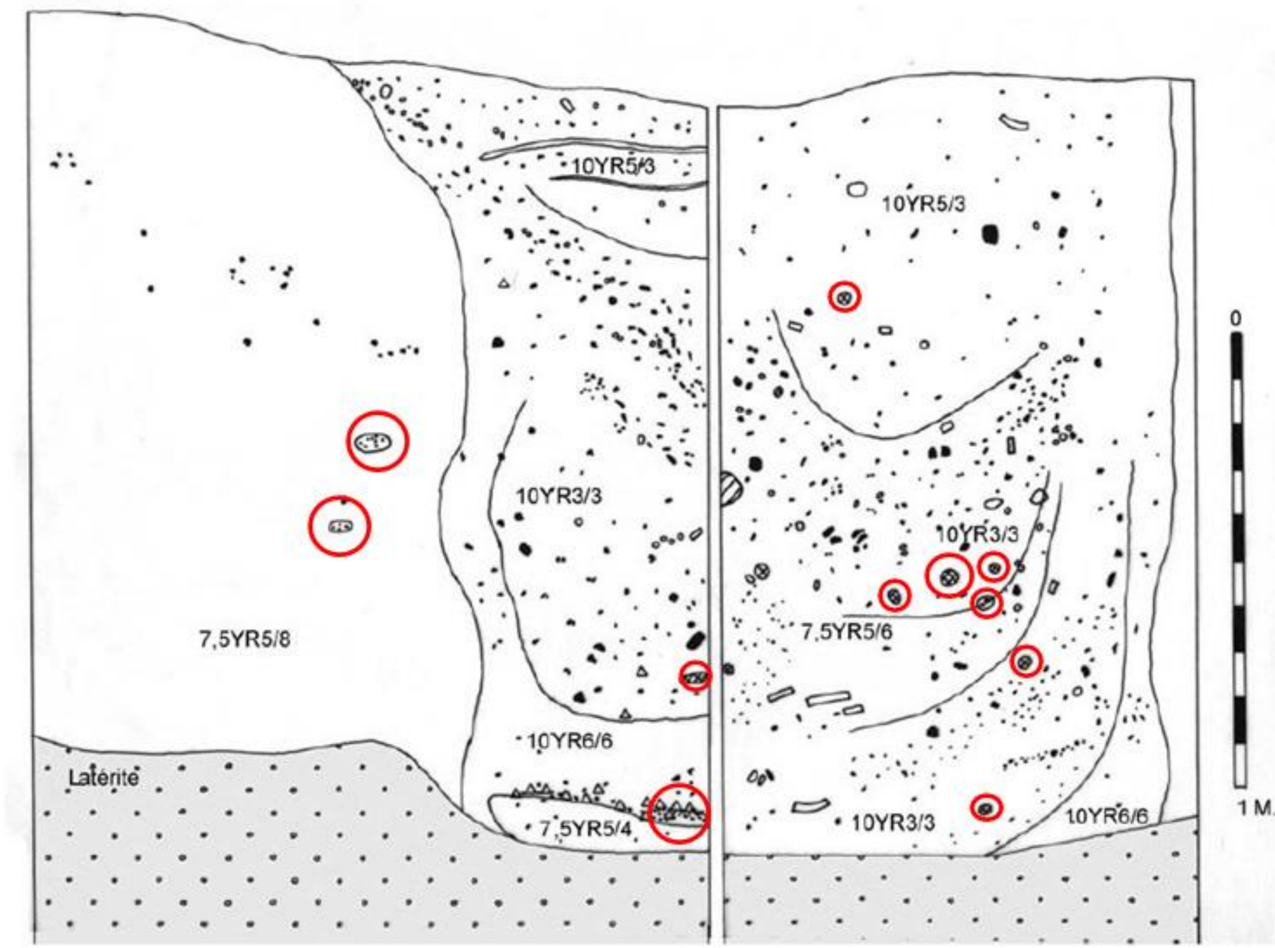


South profile of trench n°10, Oveng site, Gabon.
A modern tree cuts through the Late (A) and Early Iron Age (C) levels. Caution must be taken dealing with samples obtained there.
Source: Clist 2005: 167, fig.5-14



Ekaremsong site, Gabon. A2-C2 squares profile. Black dots: lithics of layer E & rectangles: potsherds from layer C. Blue circle pinpoints an area where either an old tree or an animal den may have been located, suggesting not to use any dating sample collected there.
Source : Clist 2005: 156, fig. 5-8, based on the Gabonese Society for Pre- and Protohistorical Research archives

Case 4D. Possible bias due to post-depositional botanical intrusion. Trees and roots cutting through archaeological deposits

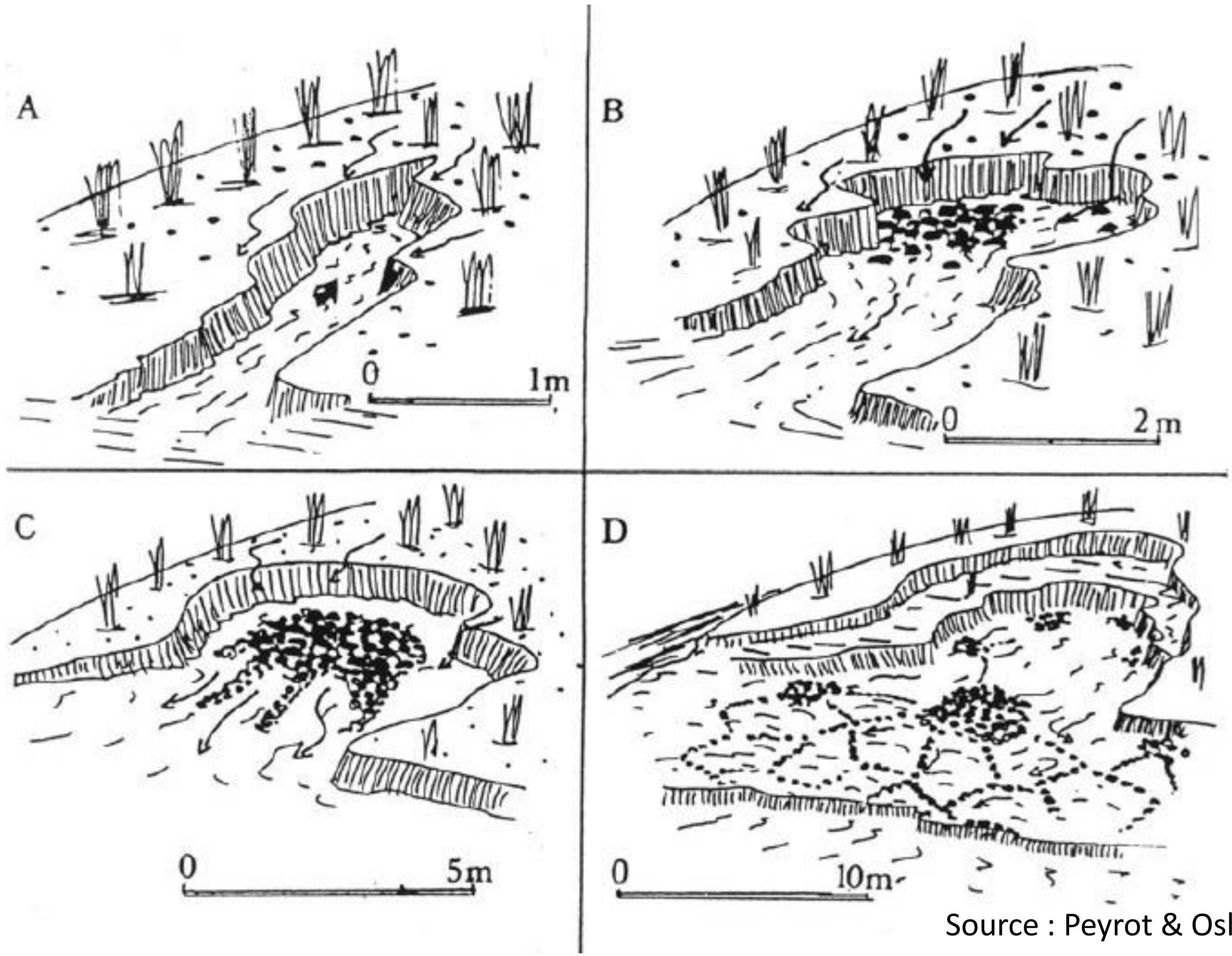


Okala site (Gabon), west (left) and north (right) profiles of Neolithic pit 11.
Red circles identify the number of roots reaching through the pit layers, as well as the surrounding sandy-clay where Late Stone Age charcoals are also found (black dots).

Source: Clist 2005: 325, fig.6-107

Case 5A. Possible bias due to post-depositional erosion

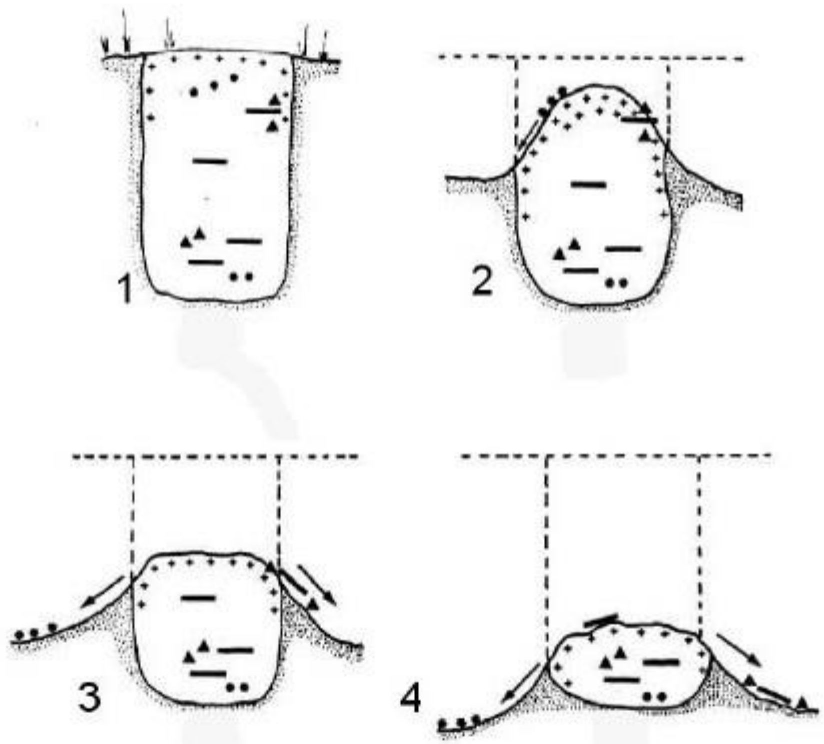
Runoff on a gentle slope can lead to the mobilization of materials and their mixing downwards to a certain depth before final burial. The dynamics depend on the climate and the vegetation. Below, B. Peyrot has modelled the process for the Lopé natural reserve, Gabon.



Source : Peyrot & Oslisly 1983, fig.4

Case 5B. Possible bias due to post-depositional erosion

Runoff on a gentle slope can lead to the erosion of archaeological pit features and the introduction of new elements resulting in the mixing of artefacts and ecofacts of different origin. The dynamics depend on the climate and the vegetation. Below B. Peyrot has modeled the process for the Lopé natural reserve, Gabon. 1: pits are dug then filled, 2: erosion removes sediments from around the pit, 3 and 4: the process goes on, reducing the volume of the feature and adding possibilities of datable material being introduced into the structure.



This process is well known in heavily eroded areas of Central Africa, e.g., the Lopé national reserve in Gabon or the central part of the Central Kongo province in the DRC (Democratic Republic of Congo).

Source : Oslisly 1992: 218, fig. 11 from a drawing done by B. Peyrot

Case 5C. Possible bias due to post-depositional erosion and bioturbation

Runoff on a gentle slope can lead to the mobilization of materials and their mixing before burial.

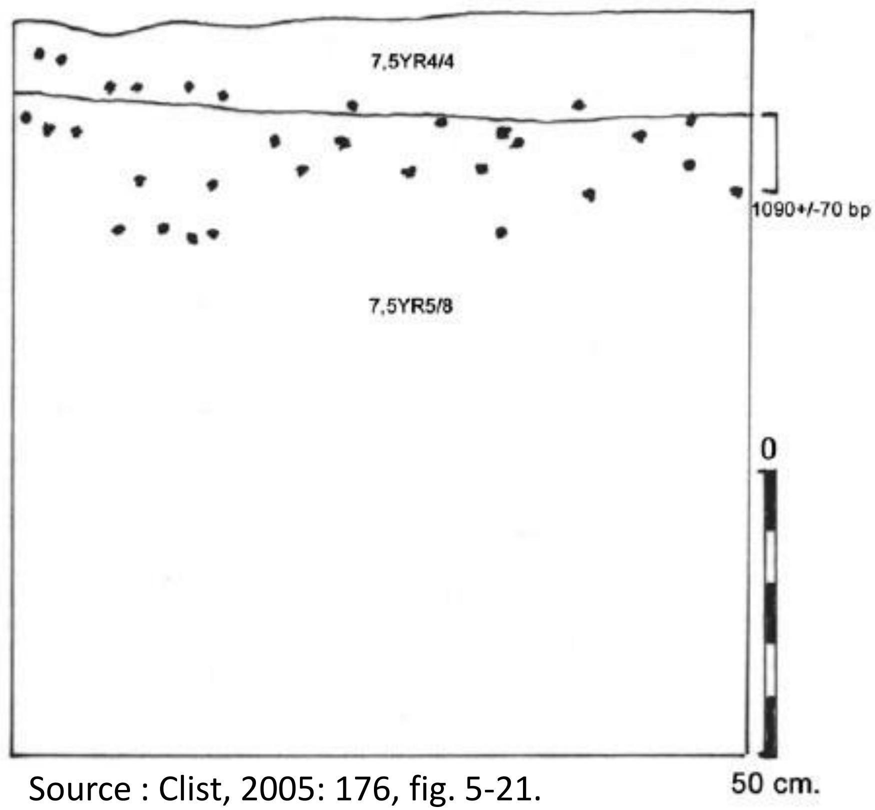
Subsequently, they may be subject to post-depositional movement to a depth that may be significant.

Site 33 of the Ofoubou River (Gabon). Wood charcoal and charred palm nuts from an Iron Age settlement spread over 20 centimeters thickness.

At Gombe Point in Kinshasa (DRC), a vertical displacement of over a meter for the Stone Age has been documented (Cahen et al. 1983).

This phenomenon is common in the equatorial zone and for open-air sites without any pit features to trap them.

As Cahen et al. wrote (p. 446): "*it is impossible to conclude a direct relationship between a dated charcoal sample and artefacts found at the same leve*l"

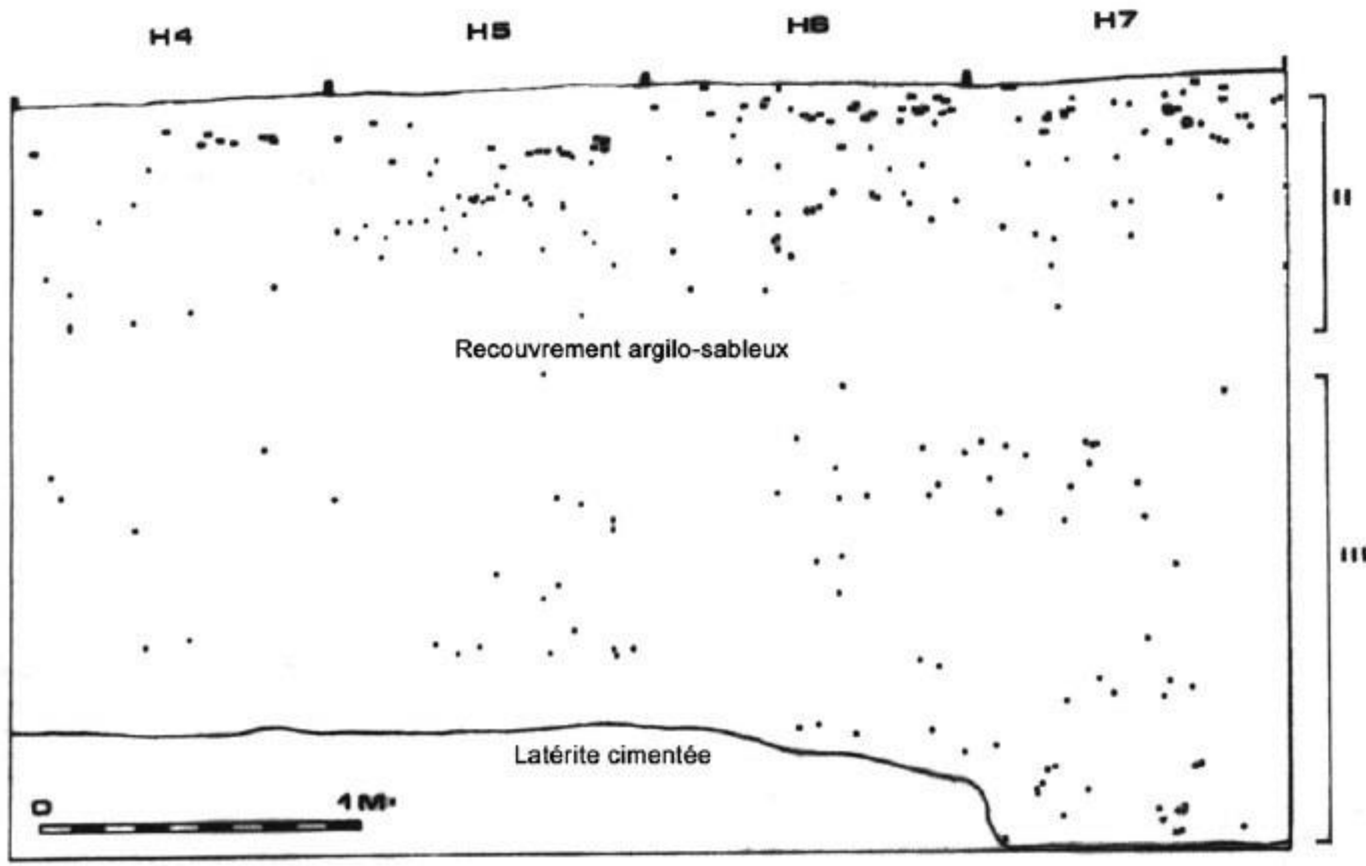


Source : Clist, 2005: 176, fig. 5-21.

Case 5D. Possible bias due to post-depositional erosion and bioturbation

Runoff on a gentle slope can lead to the mobilization of materials and their mixing before burial. Subsequently, they may be subject to post-depositional movement to a depth that may be significant.

Below: Libreville 'Camp des Gardes' site (Gabon), squares H4-H7: lithics (black dots) scattered in the sediment forming two large concentrations (II and III). Pottery aligned at the top of the profile (black rectangles). Charcoal as well as lithics were likely moved the same way.

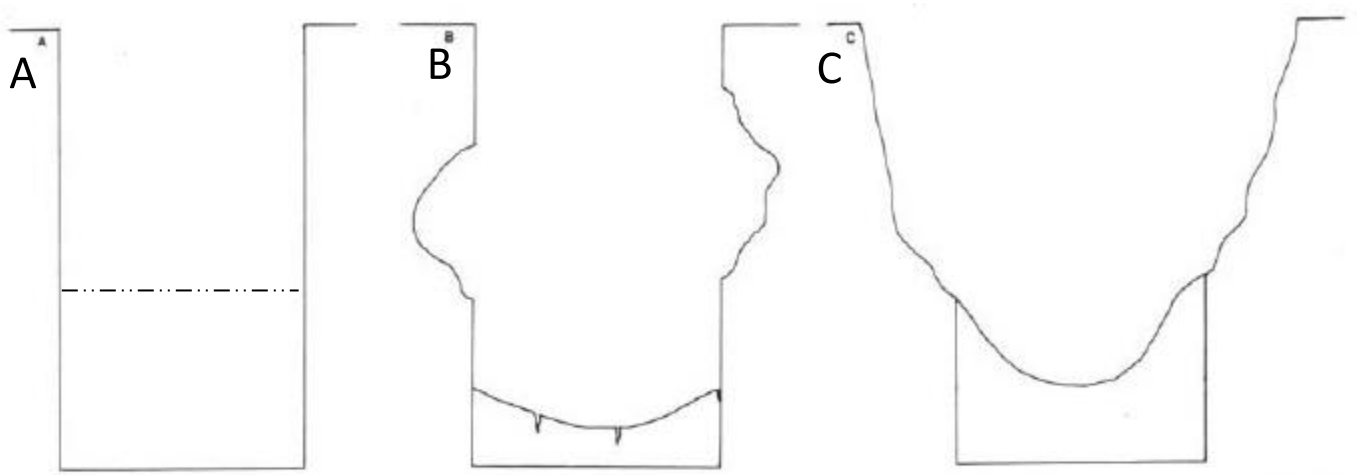


Source : Clist, 2005 based on the Gabonese Society for Pre- and Protohistorical Research archives

Case 6A. Possible bias due to the natural evolution of a pit left unfilled in an Iron Age village

Evolution of an excavation trench left open for several days and subjected to several storms in 1987. Water catchment area of 2 square metres, depth 1.80 metres. Okala site, trench G1/G2, width 1 meter.

Early rainy season of March 1987: A: profile of the trench, day 1, 50% filled with rainwater. B: Trench profile on day 4, rainwater has been drained, and part of the profile fell at the limit of the old water level. Deposition of silty layer at the bottom and appearance of drying cracks. C: trench profile, day 7, successive collapses after several periods of rain resulting in a new, V-shaped deposit profile.



Important remark: Any older artefacts and ecofacts (charcoal etc.), especially from Stone Age times, stratified 'under' the village pit, will fall into it during stages B and C.

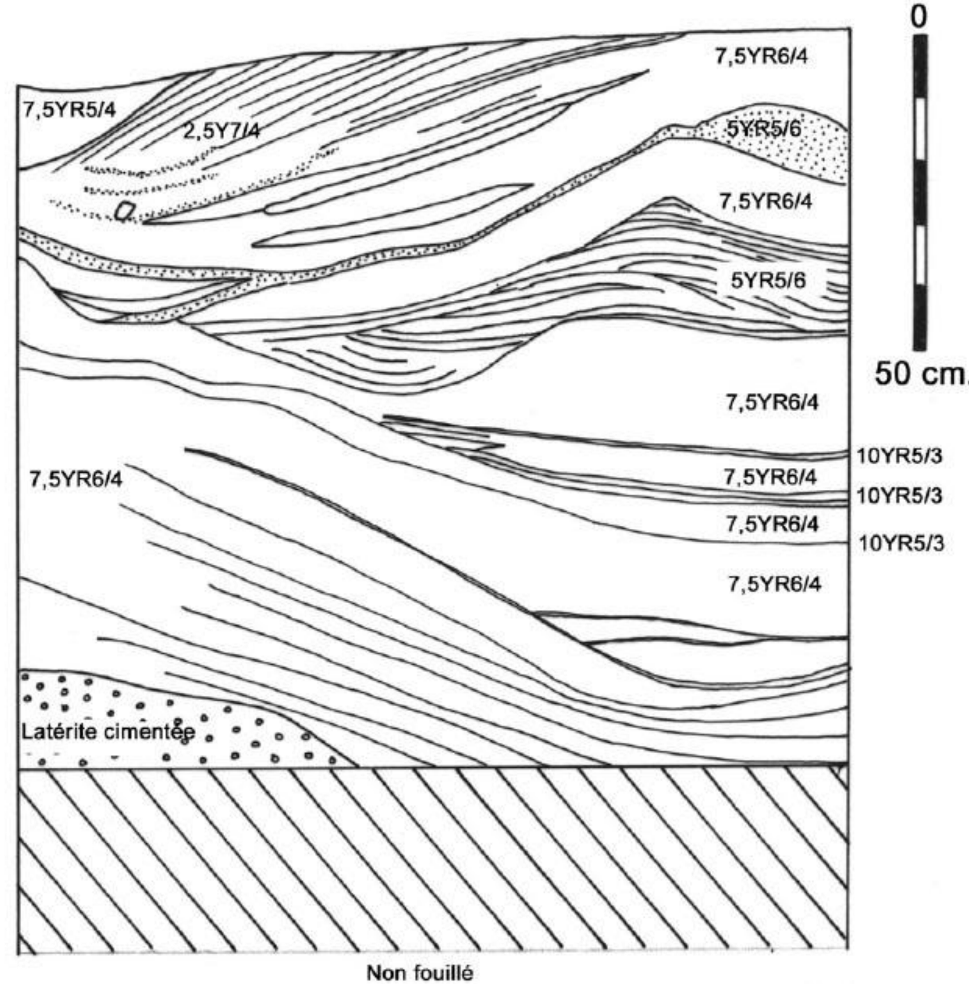
Source : Clist 2005: 180, fig. 5-24

Case 6B. Possible bias due to the natural evolution of a pit left unfilled in an Iron Age village

Following from slide n°23, the experience was extended to observe how the trench was filled up and the time needed for this to occur.

" ... there was a rapid filling from September 1987 to December 1988. At this point, the trench was almost completely filled with only a small depression still visible at the top of the trench. A permanent water pool enabled shrubs to slowly develop.
The period from December 1988 to April 1989 saw the complete filling of the depression. " (see profile at right)

It was possible to observe surface sheet erosion carrying Late Stone Age lithics and charcoal extracted from neighboring up hill areas being washed into the pit.

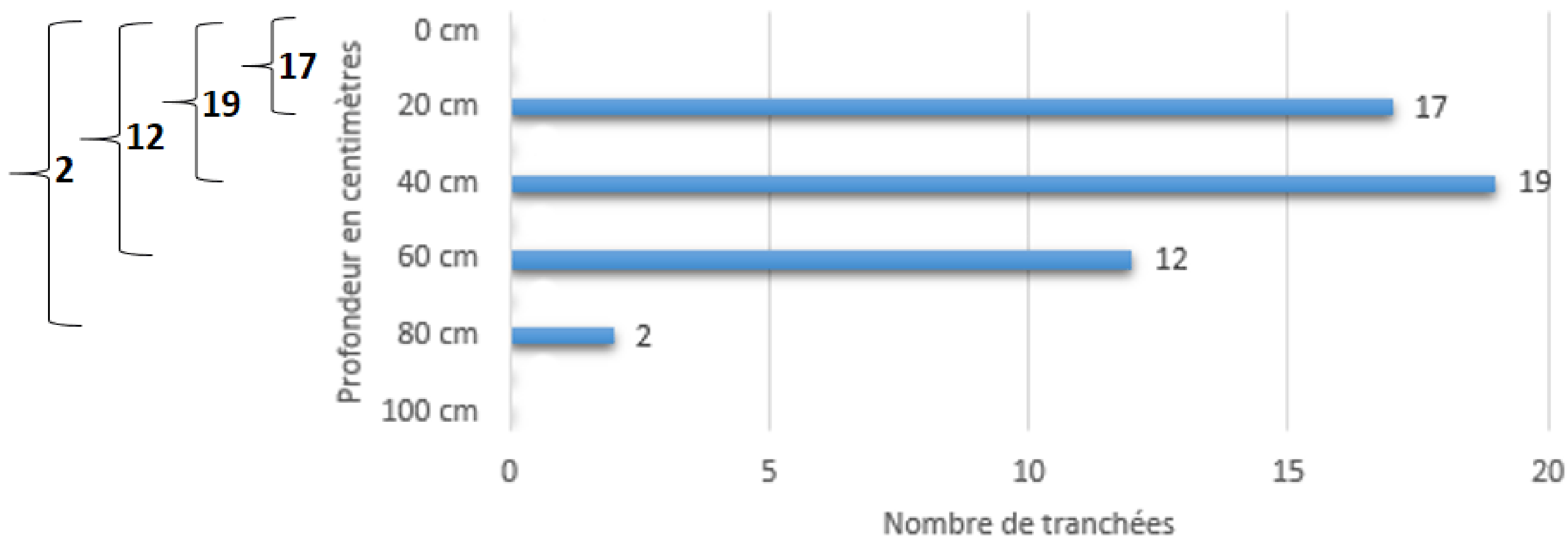


Source : Clist 2005: 182, fig. 5-25.

Case 7A. Possible bias due to post-depositional human agency

Runoff on a gentle slope can lead to the mobilization of materials and their mixing before burial. In addition, the trampling of the soil by its inhabitants can lead to displacements of up to several centimeters, not to mention the mixing of the soil, artefacts and ecofacts by the cultivation of the plot by the generations to follow.

The site chosen for this topic is the Kindoki site in the DRC, occupied since the 14th century. It was discovered that 2 trenches had their archaeological material vertically scattered over 80 cm, 12 trenches over 60 cm, 19 over 40 cm and just 17 over 20 cm in thickness.

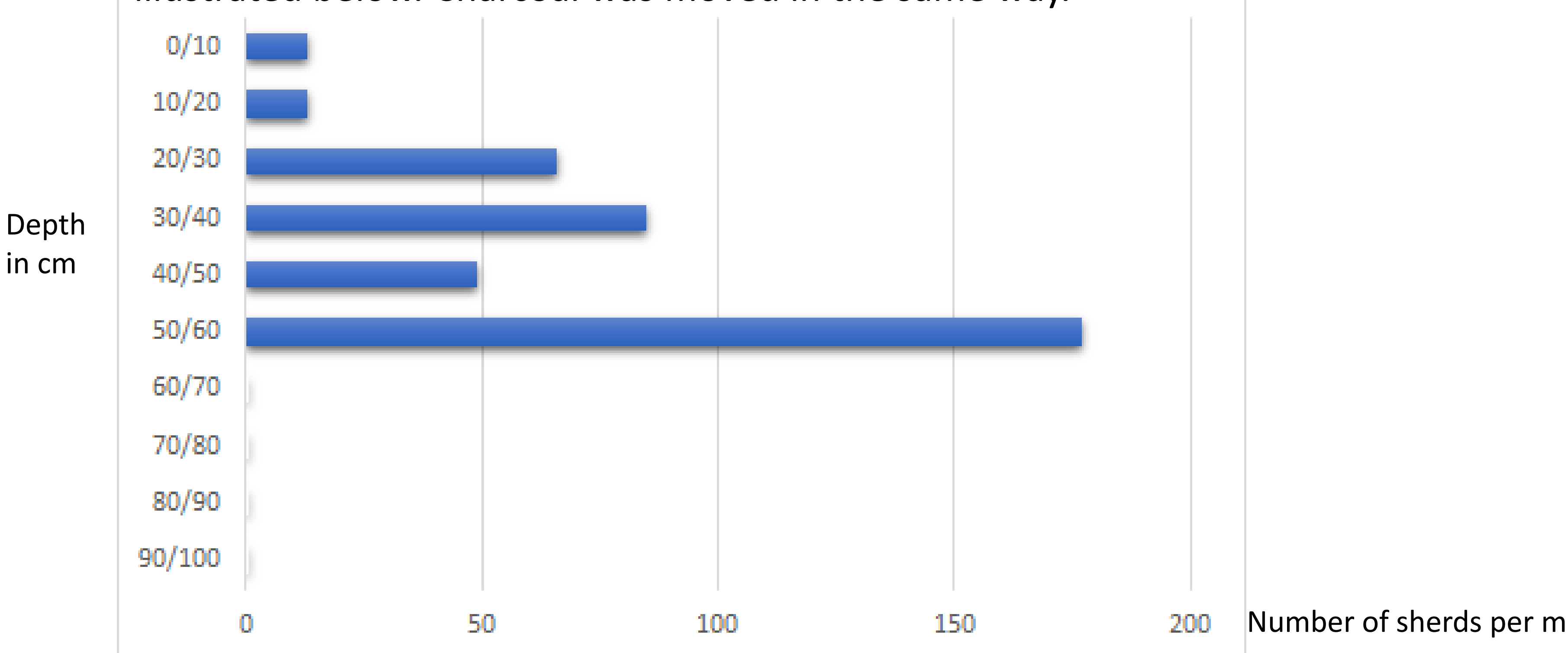


Source: Clist et al. 2018: 62, fig. 9.1.

Case 7B. Possible bias due to post-depositional human agency

At the Kindoki site in the DRC, dated from the 14th to the early 19th century, the earliest pottery of the Kindoki Group (14th and early 15th century) originates from -50/-60 cm.

Continuous human occupation of the hill, associated with runoff on a gentle slope can lead older artefacts to be exposed, and incorporated into the new layers. But it is believed it was the subsequent cultivation of the garden plots during the generations that follow that led Kindoki Group pottery to be found from -60 cm to the surface as illustrated below. Charcoal was moved in the same way.

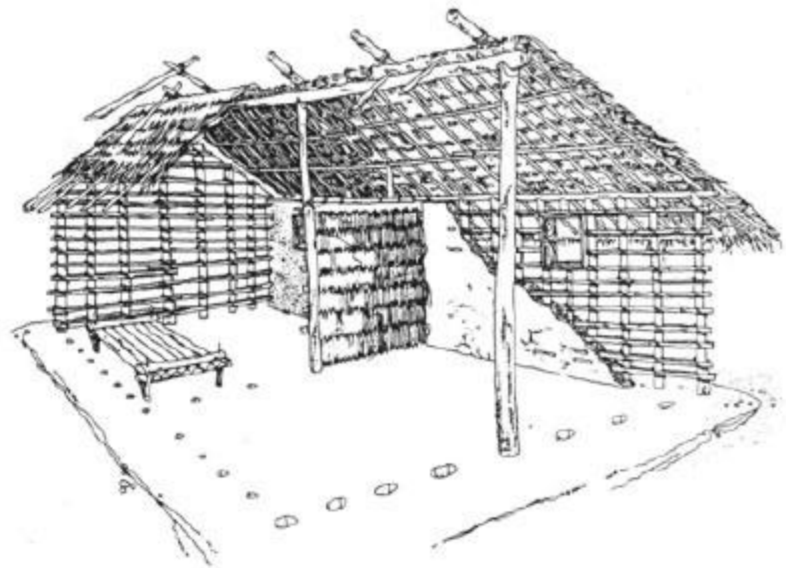


Source: Clist et al. 2018: 138, fig. 11.7, vertical distribution of Kindoki Group pottery in trench 23 excavated over 30 m².

Case 8A. Possible bias due to post-depositional human agency: post holes and house walls interacting with the deposition of organic material …

A.

B.



Structure de case bantoue.

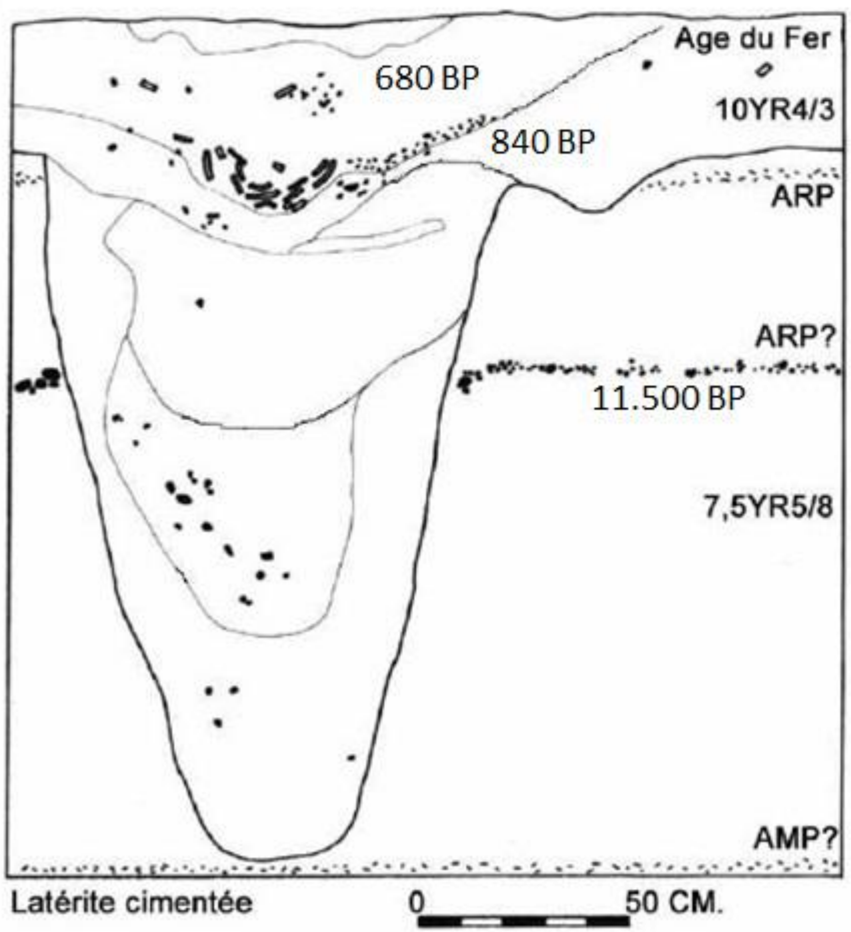
Left, burnt clay piece with impressions of a wooden structure, probably part of a house wall (Okala site, Gabon, pit 13) with material extracted from a pit.
Right, plan of a village house showing the post holes sometimes encountered during excavations.

Source: left Clist 2005; right Philippart de Foy 1984: 111.

Case 8B. Possible bias due to post-depositional human agency: house walls interacting with the deposition of organic material …

Modern Nduizi village, Lower Congo, DRC. Picture of a house wall containing palm nuts, charcoal and Early Iron Age Kay Ladio Group potsherds which came from the borrow pit used for construction in land previously occupied. When the house is abandoned, its walls components will be mixed with 21st c. material. Source: Clist 2018 mission, unpublished.

Case 8C. Possible bias due to post-depositional human agency: refuse pits interacting with the deposition of organic material …

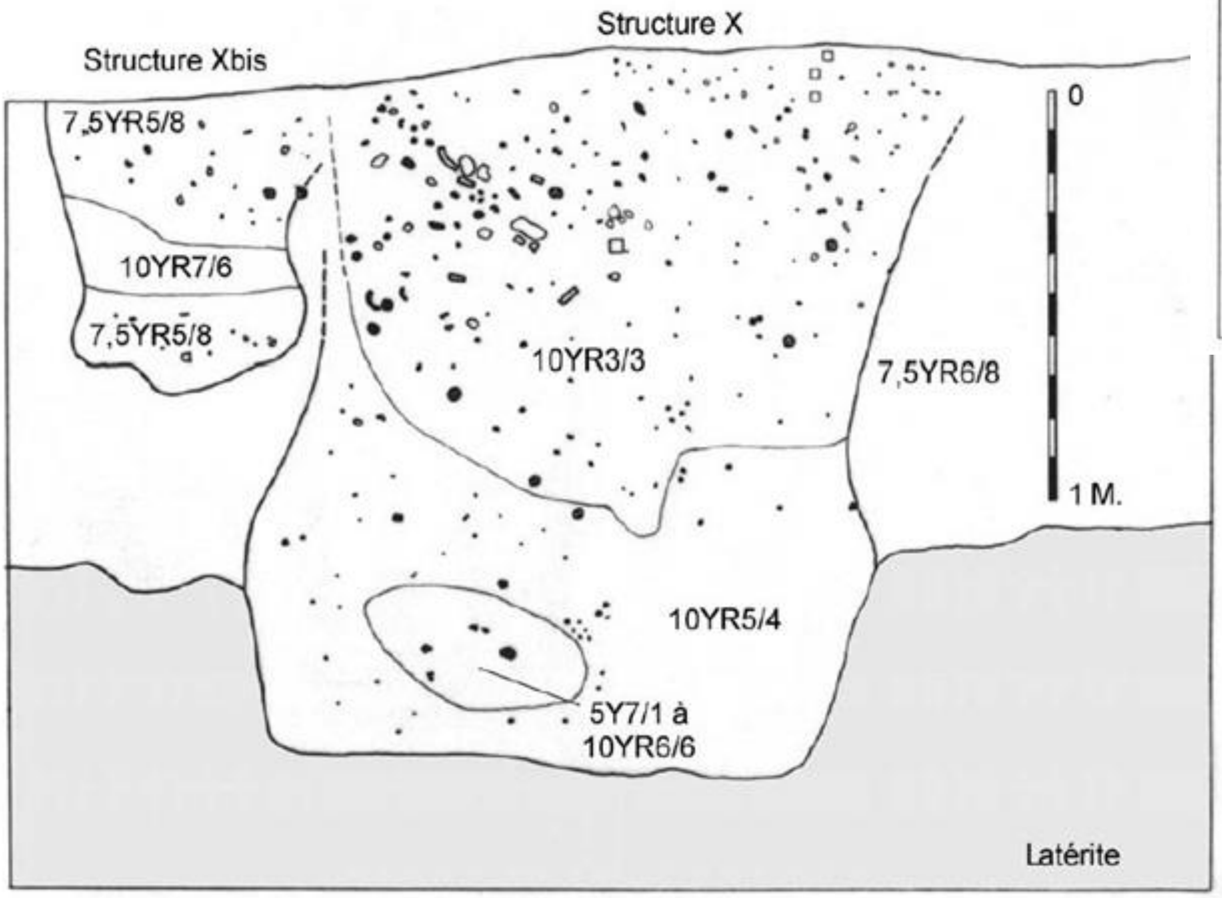


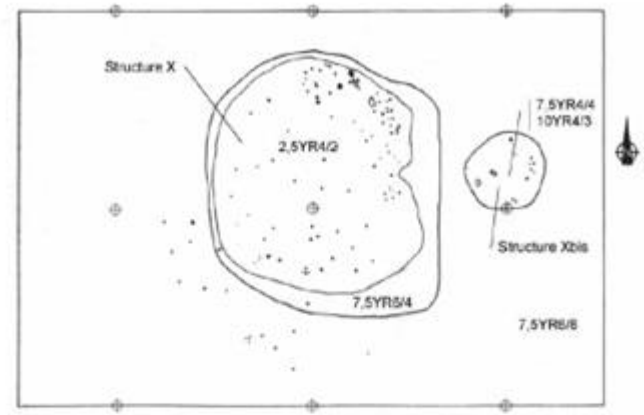
Angondjé site (Gabon):
Succession of archaeological levels, from top to bottom, Late Iron Age (680 & 840 BP, Angondjé Group), Early Iron Age (Oveng Group c. 1,800 BP), Neolithic (Okala Group, c. 2,500-2,200 BP), undated Late Stone Age (?), probably Late Stone Age (11,500 BP), undated Middle Stone Age on top of the laterite (however, at the nearby Okala site, it was twice dated to 43,000 BP and ≥ 40,000 BP).

The Late Iron Age pit intersects all the archaeological levels, except the lower lying MSA one.

Source : Clist 2005: 153, fig. 5.6.

Case 8D. Possible bias due to post-depositional human agency: refuse pits interacting with the deposition of organic material …



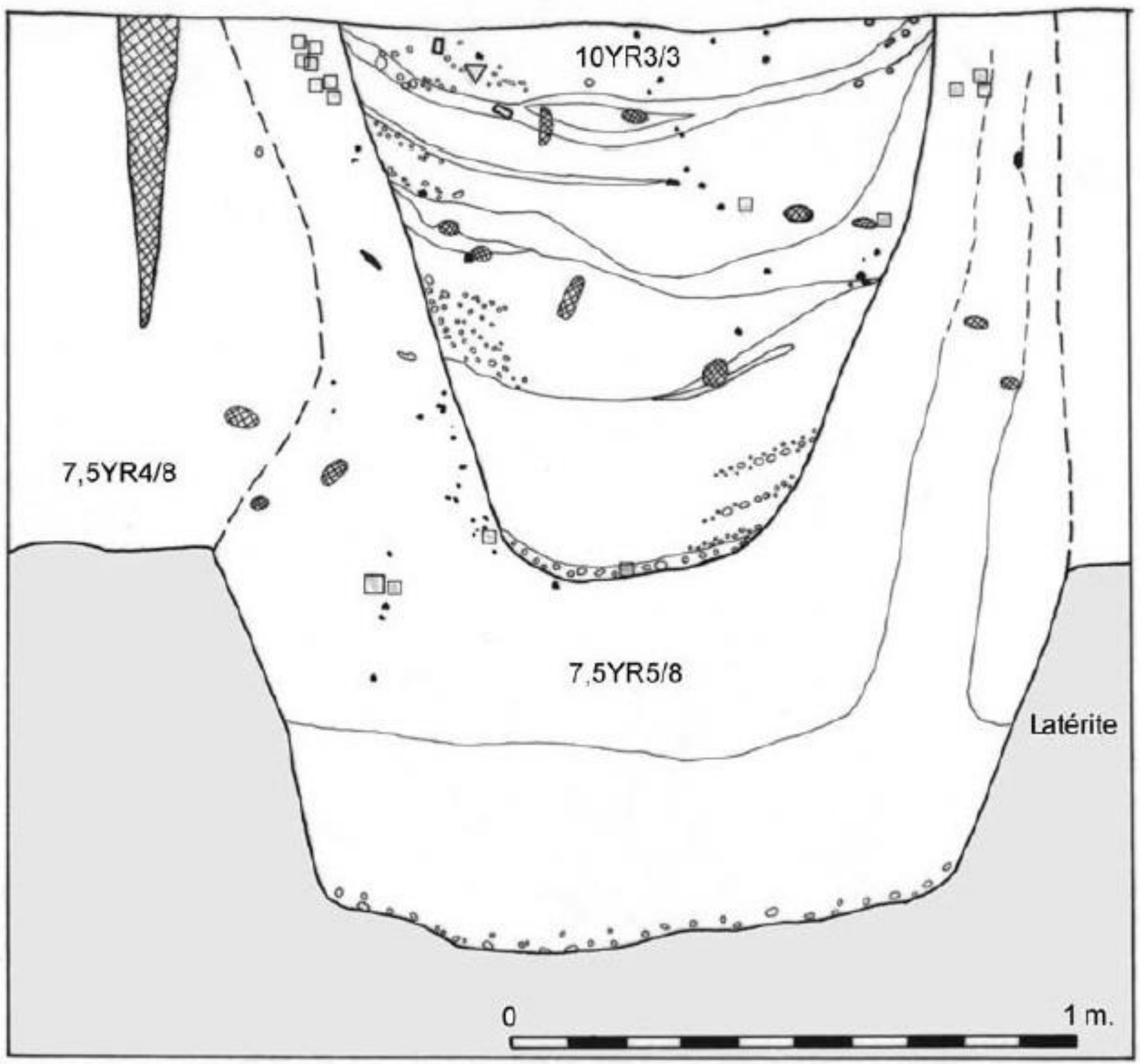


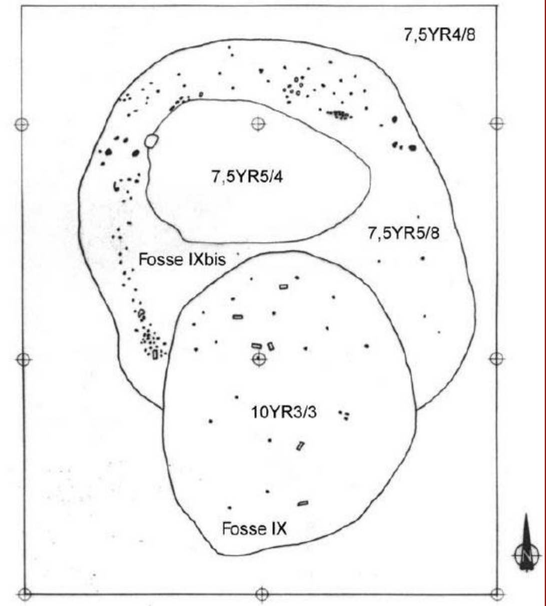
Okala site (Gabon):
Two pits are connected in their upper parts.

Pit X is Neolithic, dated to c. 2,500 BP, while pit X’ is Late Iron Age.

Source : Clist 2005, fig. 6-99.

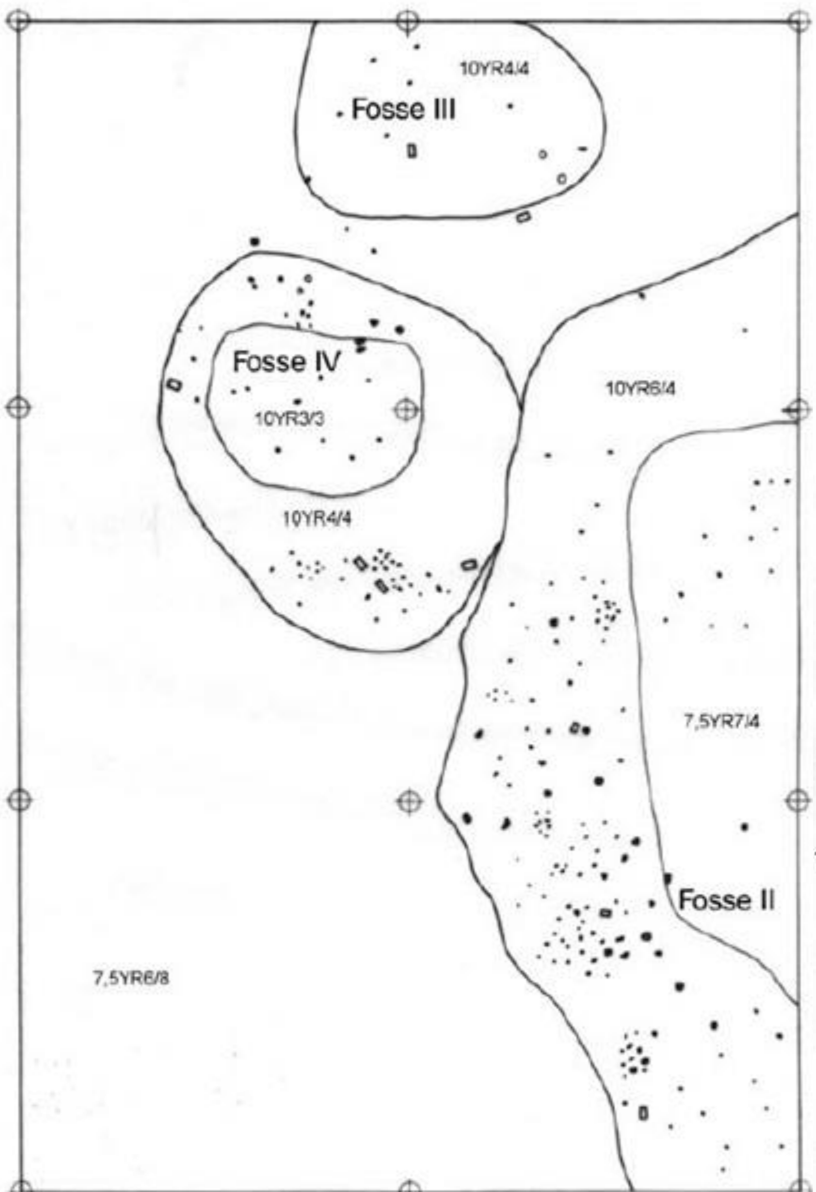
Case 8E. Possible bias due to post-depositional human agency: refuse pits interacting with the deposition of organic material …



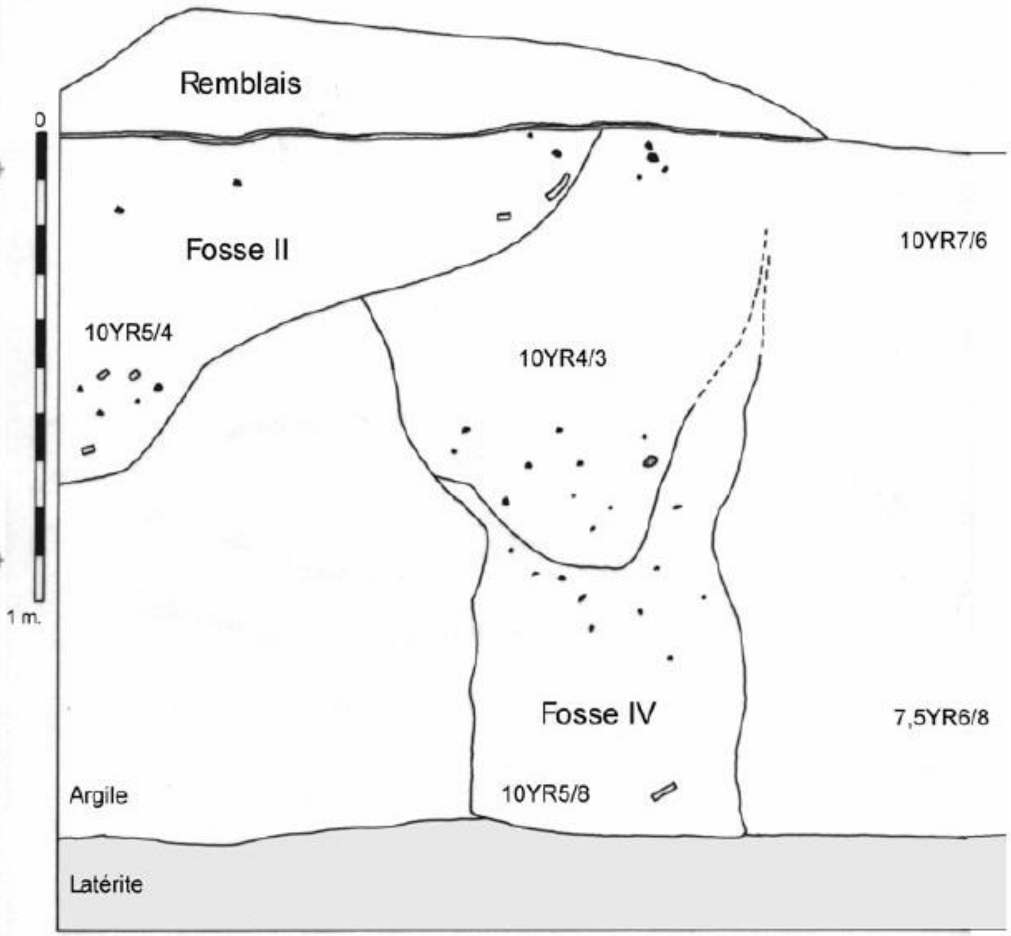


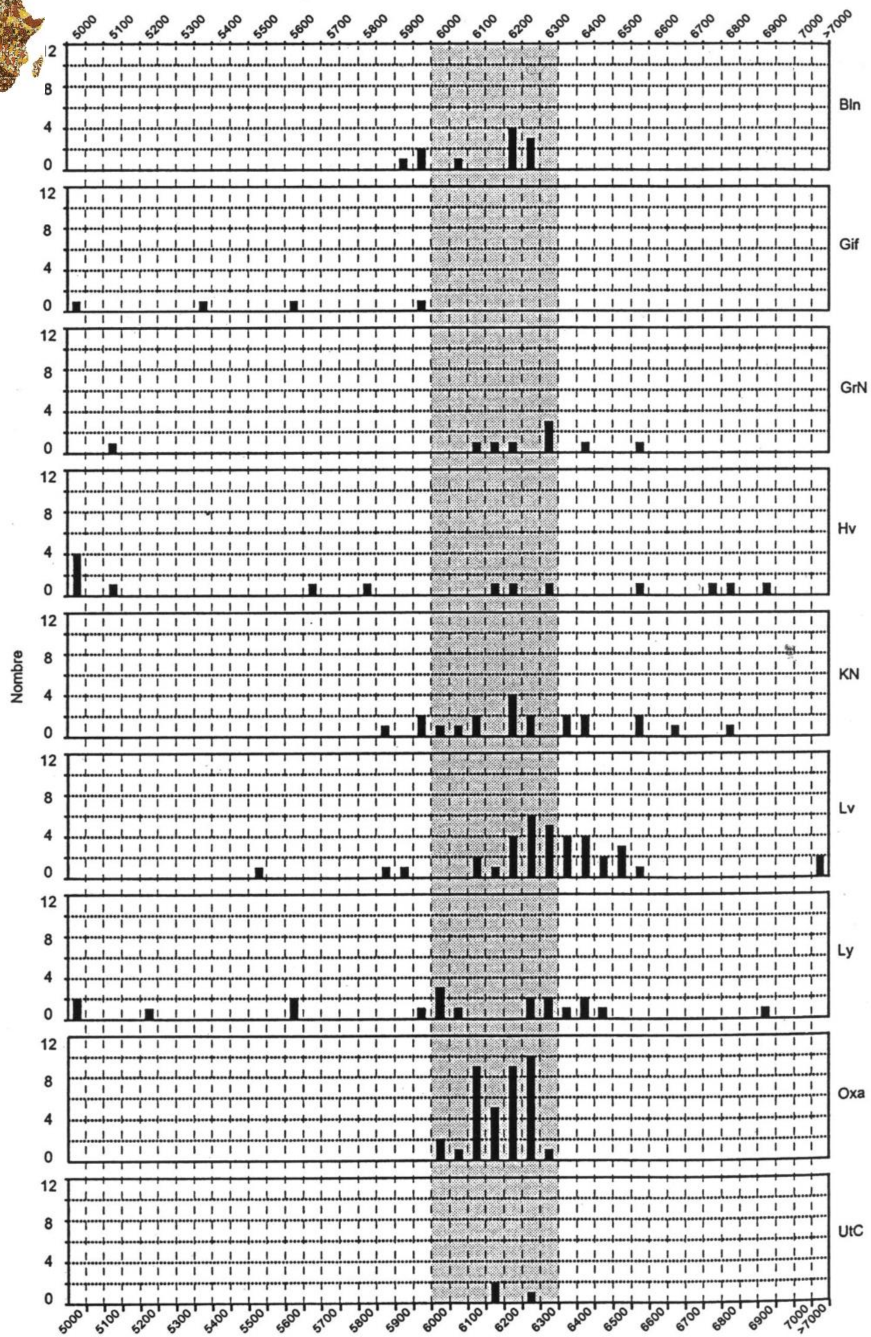
Okala site (Gabon):
North profile of pit 9 (Late Iron Age), and pit 9’ (Neolithic).
The LIA pit was dug into the older pit. Roots intersect both pits.
Note post hole on the left of the pit, probably modern.
Source : Clist 2005, fig. 6-90.

Case 8F. Possible bias due to post-depositional human agency: refuse pits interacting with the deposition of organic material …



Okala site (Gabon): a Late Iron Age pit (#2) dated to 440 & 560 BP) cuts into the upper layers of a Neolithic pit (#4) dated to 2,250 BP).
Source : Clist 2005.





Case n°9. Possible bias from the dating laboratory

All 14C dates obtained in 1999 from the Belgian Danubian Neolithic according to the laboratory involved, based on the known period of occupation shown in grey.
Source: Jadin, 1999.

From the most to less reliable labs:

OxA (Oxford, UK) >

Bln (Berlin, Allemagne) >

UtC (Utrecht, Pays-Bas) >

Lv (Louvain, Belgique) >

GrN (Groningen, Pays-Bas) >

KN (Köln, Allemagne) >

Ly (Lyon, France) >

Hv (Hannover, Allemagne) >

Gif (Gif-sur-Yvette, France) >

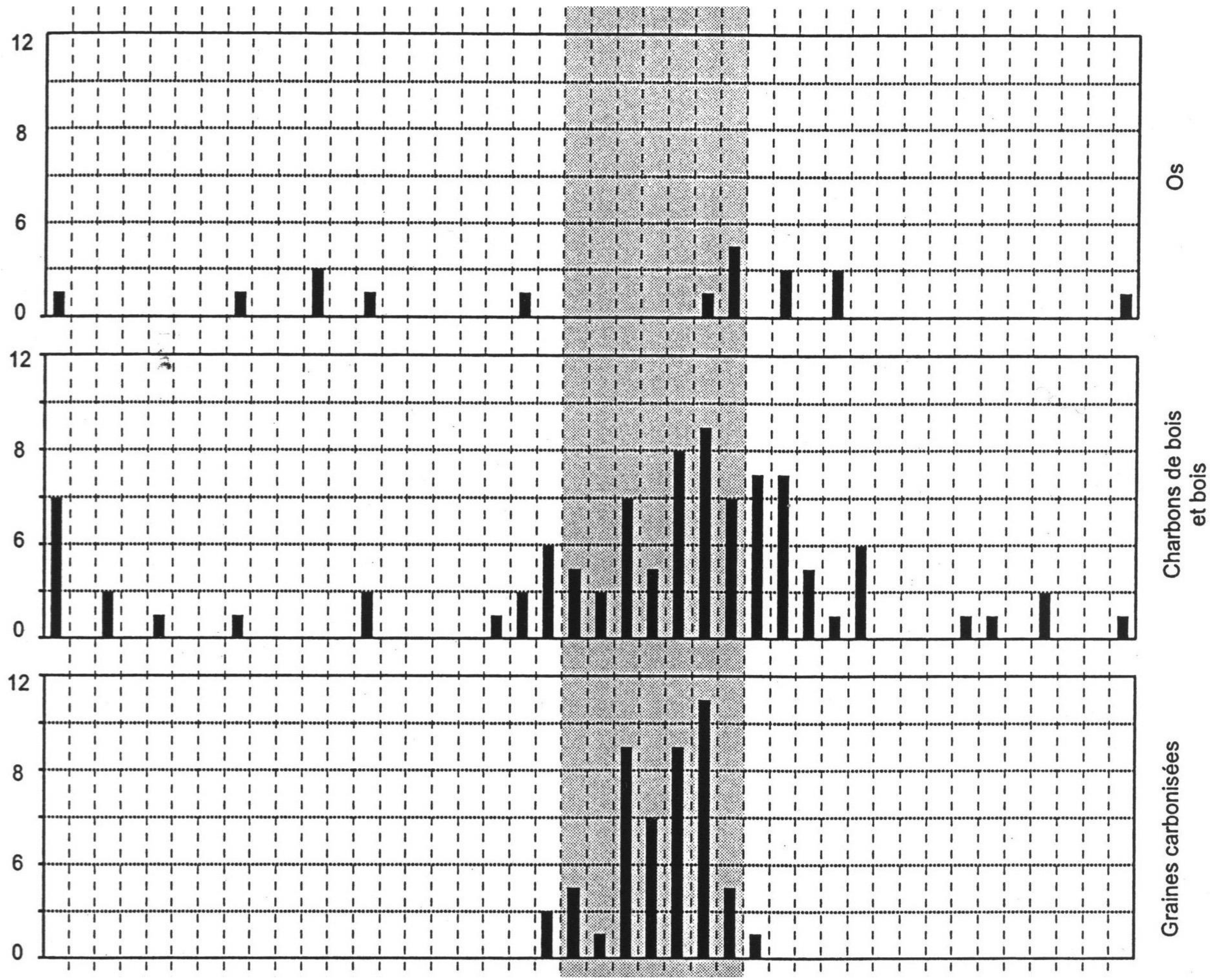
Case 10. Possible bias due to differences in the material dated

Grey zone: known periodization of the European Danubian Neolithic

Bone

Wood and wood charcoal

Carbonized fruit endocarps and seeds

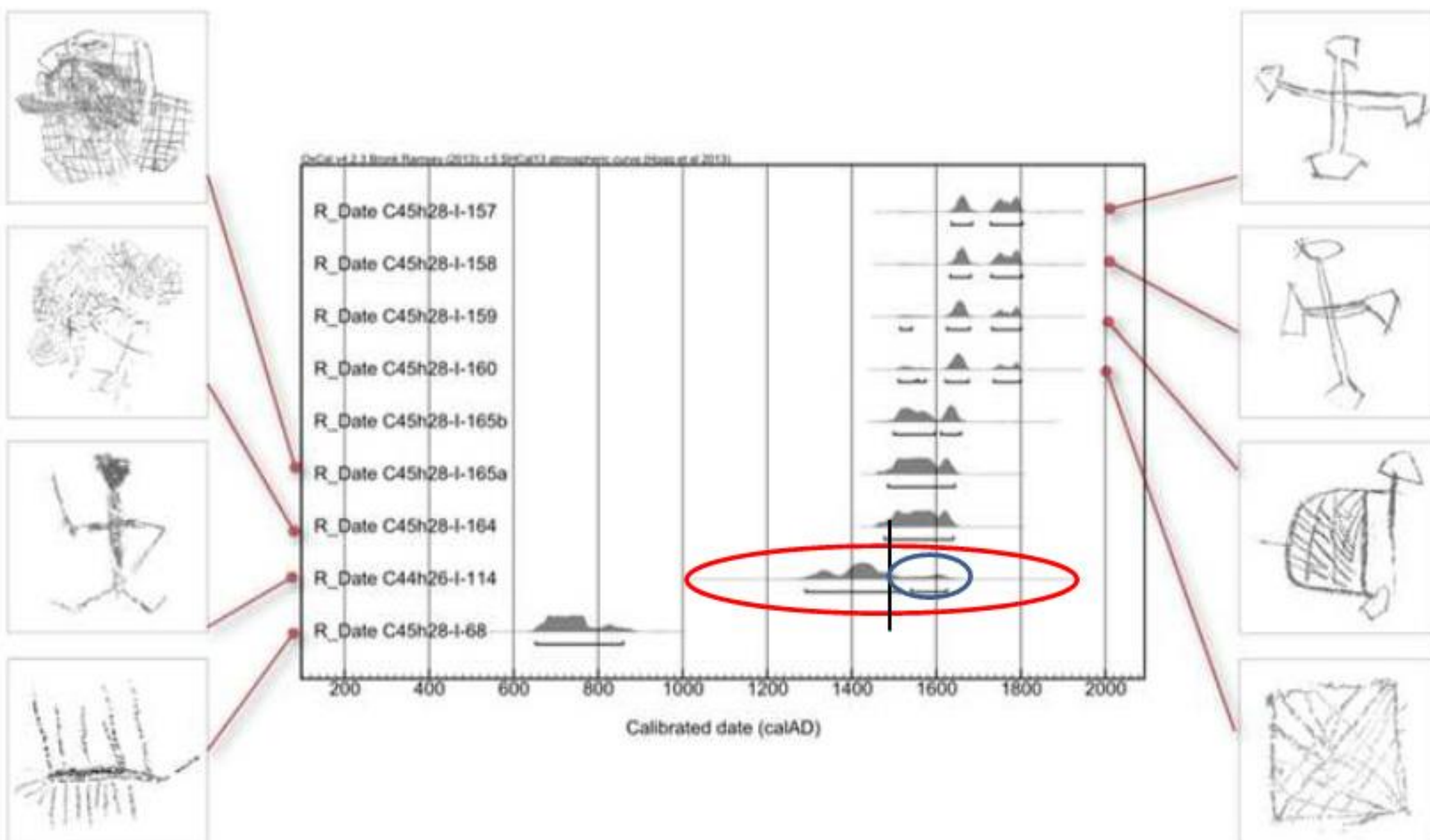


Comment: short-lived material is the best, like pearl millet. Wood charcoal is accurate enough if the contexts are correctly considered (see all slides above).

Case 11. Possible bias due to too much confidence in the calibrated date

Rock art of the Lower Congo. Depiction from Tovo cave of a man in a dancing pose and showing a sabre or a sword. These were introduced to the Kongo kingdom after AD 1483 (black line). The best period is represented by the blue oval. It is thus outside the most probable segments of the calibrated date which would push the chronology to before AD 1483.

Source: Heimlich 2016: 1276, fig. 5.



Case 12 (1/4). Very special case of the Oboui site in the Central African Republic. The site has been used to support a very old African iron metallurgy, before 2000 BC (Zangato & Holl 2010). The context has been challenged.

* ZANGATO (E.), 2007, *Les ateliers d'Oboui : Premières communautés métallurgistes dans le nord-est du Centrafrique*, Editions Recherche sur les Civilisations (ERC), Paris.
* ZANGATO (E.) & HOLL (A.F.C.), 2010, On the Iron Front: New Evidence from North-Central Africa, *Journal of African Archaeology*, 8, 1, pp.7-23.

Published comments:

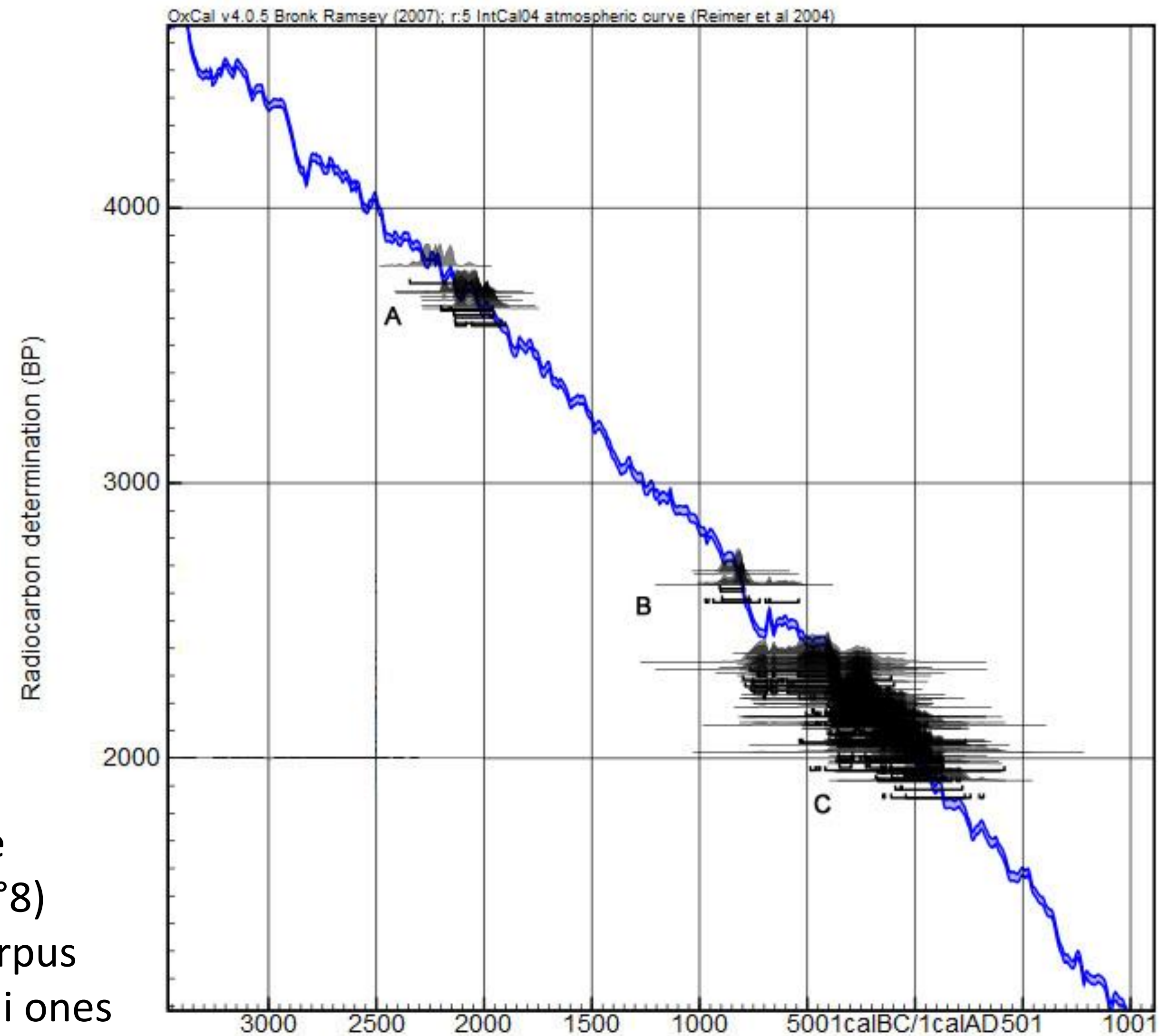
* CHIRIKURE (S.), 2010, On Evidence, Ideas and Fantasy: The Origins of Iron in Sub-Saharan Africa. Thoughts on E. Zangato & A.F.C. Holl's "On the Iron Front", *Journal of African Archaeology*, 8, 1, pp. 25-28.
* CRADDOCK (P.), 2010, New Paradigms for Old Iron: Thoughts on E. Zangato & A.F.C. Holl's "On the Iron Front", *Journal of African Archaeology*, 8, 1, pp. 29-36.
* EGGERT (M.), 2010, Too Old? Remarks on New Evidence of Iron Working in North-Central Africa, *Journal of African Archaeology*, 8, 1, pp. 37-38.
* MACEACHERN (S.), 2010, Thoughts on E. Zangato & A.F.C. Holl's "On the Iron Front", *Journal of African Archaeology*, 8, 1, pp.39-41.
* CLIST (B.), 2012, Vers une réduction des préjugés et la fonte des antagonismes: un bilan de l'expansion de la métallurgie du fer en Afrique sud-saharienne, *Journal of African Archaeology*, 10, 1, pp.71-84

Case 12 (2/4): The radiocarbon dates from Oboui in the CAR are still very isolated

A : 6 calibrated ^{14}C dates from Oboui = 2150 - 2000 BC

B : calibrated ^{14}C dates from Gbabiri = 900 - 800 BC

C : corpus of ^{14}C dates from Central Africa = 800 BC – AD 200.



Source: Clist 2012: fig. 1

Observation: The dates from Gbabiri are located before the 'Hallstatt plateau' (see slide n°8) and are rather close to our corpus from Central Africa. The Oboui ones are 1,000 years before them, without any intermediate site.

Case 12 (3/4): The radiocarbon dates from Oboui in the CAR are still very isolated

Context of the charcoal samples: B, so quite good (see Slide 6; cf. Waterbolk 1971)

But

- Stratigraphic inconsistency in 2010 presentation,
- Excavated structures across all layers,
- No real archaeological analysis of the material found associated with the 14C dates, especially the pottery,
- Very isolated dates in relation to the regional context (see Slide 37),
- Too good a preservation of the iron remains in relation to their chronology and other similar finds of iron working evidence in the CAR (e.g., NDANGA (J.-P.), 2005, *Du minerai au métal ferreux : étude des vestiges du site de Pendere-Sengue à Bangui (République Centrafricaine)*, DEA Thesis, Université de Yaoundé I),
- Inconsistency of the proposed results in relation to the local cultural sequence,
- The site's description by E. Zangato explains the importance of local sheet erosion in modern times, thus making the mixing of the dated material over thousands of years ago convincing (see slide 39).

Conclusion: the ancient dates from Obooui must be put aside for the time being because of their questionable context.

Case 12 (4/4): The radiocarbon dates from Oboui in the CAR are still very isolated

[… Ce site a été découvert à la suite d’un violent orage qui s’est abattu sur la région au mois de février 1992. Sur plusieurs centimètres, le ravinement des eaux de ruissellement a creusé le sol. C’est alors qu’est apparu une couche archéologique […].
… construction d’un petit barrage pour préserver la zone, soumise aux passages fréquents des populations locales et des troupeaux de bœufs.] (Zangato, 2007, p.11) …].

[… This site was discovered following a violent rainstorm that hit the region in February 1992. Run-off water eroded the soil over several centimeters resulting in the exposure of the archaeological layer [...].
... the area is frequently affected by the passage of local people and by herds of oxen]. (Zangato, 2007, p.11) …].

The danger of not seriously considering stratigraphic contexts when collecting, choosing and sending samples to the dating laboratory. Sample contamination by older or younger carbon can result in serious discrepancies as shown below.

Effect of sample contamination by Modern or Radiocarbon Dead Carbon on the True sample age (Polach and Golson 1966)

True Sample	Approximate Age after contamination with Modern (1950 AD) Carbon on the true sample age			
Age	**1% Modern**	**5% Modern**	**20% Modern**	**50% Modern**
900 BP	890	850	700	440
5000 BP	4950	4650	3700	2100
10000 BP	9800	9000	6800	3600
20000 BP	19100	16500	10600	5000
30000 BP	27200	21000	12200	5400
100000 BP	37000			

True Sample	Approximate Age after contamination with Old (Radiocarbon Dead) Carbon on the true sample age			
Age	**5% OLD**	**10% OLD**	**20% OLD**	**50% OLD**
500 BP	900	1300	2200	6000
900 BP	980	1770	3200	6630
5000 BP	5400	5800	6700	10500
10000 BP	10400	10800	11700	15500
20000 BP	20400	20800	21700	25500

Source : https://www.radiocarbon.com/carbon-dating-pretreatment.htm