Our iron smelting ^{14}C dates from Central Africa: from a plain appointment to a full blown relationship

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ABSTRACT: This paper reviews the ^{14}C dates associated with early iron smelting in Central Africa before 1900 BP.

All of the archaeological sites from which these early dates have been obtained are critically examined. For example, each dated sample is checked for its stratigraphic integrity, its degree of association with dated artefacts, and its associated ceramic sequence.

The series of 'good' 14C dates obtained from this re-appraisal is then presented at the regional level in order to provide a new paradigm of the expansion of iron metallurgy through Central Africa, from Cameroon to Congo.

The work presented here follows several published papers and book chapters, and is based on research within the region by the author which began in 1982.

Keywords: Central Africa, Sub-Saharan Africa, Iron Age, Neolithic, radiocarbon dating, iron smelting, village expansion, iron smelting expansion.

Introduction

Back in 1977, at the time that the first synthesis of radiocarbon dates from Central Africa was published in the *Journal of African History*, the oldest date for iron metallurgy was around the 4th century AD (Maret, et al., 1977; David, 1980). Following the excavations carried out in the Upemba depression of Zaïre (now the Democratic Republic of Congo, DRC), we glimpsed that from the 6th century AD onward, iron was widely known and used in the south-eastern reaches of the Congo river basin. This was later pushed back in time to the 3rd century AD, in the Lubumbashi area (DRC) (Maret, 1978, 1982, 1985; Anciaux de Faveaux et Maret, 1984).

In 1985 the laboratory results from the Obobogo archaeological site (Cameroon), which had been excavated in 1983, enabled us to jump to 2120 and 2310 BP (Maret, 1985). There iron slag was found in deep refuse pits, which had been dug from the village level which was later disturbed by fields and buildings.

The evidence unearthed in Cameroon was quickly confirmed by fieldwork carried out in Gabon. In 1985, the earliest iron in Gabon was cited at 1850 BP (Clist, et al., 1986; Clist, 1989a). Soon, however, a series of radiocarbon dates closely associated with archaeological evidence identified an Early Iron Age period in which iron smelting bracketed between 2350 and 2050 BP around the country (Digombe, et al., 1985; Schmidt, et al., 1985; Clist, 1989b; regional approach in Lanfranchi and Clist, 1991).

It must be stressed that the Gabonese data demonstrates an unequal distribution of early iron smelting and iron use across the country. While in the north-west of Gabon there is no evidence for iron production around 2300 BP, evidence brought to light during excavations led by Peter Schmidt (Digombe, et al., 1987; Clist, 1995, 1997, 2005) suggests that smelting existed on quite a large scale in the south-east, in the Haut-Ogooué province at Moanda.

Before progressing to consider the modern picture of early iron smelting in Central Africa it is important to mention two methodological issues: the context of the dates, and the identification of the associated archaeological data. H.-P. Wotzka has been able to state very recently that, "Collecting dates is tantamount to running into continual trouble, to do first with missing, incomplete, inaccurate or distorted contextual information [...] considerable time is wasted trying to track down or cross-check information which every researcher would have submitted along with their samples". (Wotzka, 2006, pp.273-274).

In an effort to resolve these issues I propose a revised, regional approach to radiocarbon dates which relate to the earliest evidence of iron smelting in Central Africa. I believe that this new work will be of major interest as a result of the dynamics of archaeological research carried out since 2005 in Cameroon and Gabon, and due to certain publications aiming to increase to c. 3000 BP the beginning of iron smelting in Africa (e.g. Zangato, 2007).

When investigating the history of iron smelting in Central Africa, there are three types of sites which need to be considered. The first type contains the remains of furnaces and direct evidence of smelting, and clearly pinpoints iron smelting centres; the second contains iron smelting residues such as tuyères and iron slag, either in stratigraphic layers or refuse dumps, which suggests iron smelting was carried out in close proximity to the excavation site. The final type of site includes those where iron objects are found, suggesting the possibility that iron implements had been imported from smelting centres elsewhere.

The corpus of radiocarbon dates and the diffusion of iron smelting

Recently, all the sites with archaeological finds relating to iron smelting were reviewed (Clist, 2005). The resultant corpus of radiocarbon dates was then discussed in close relationship with their local context: degree of association with artefacts, stratigraphy, various typological or laboratory analyses of artefacts, etc.

This work has been updated to incorporate data found up to December 2008 and a new catalogue of early iron smelting sites from Central Africa before 1900 BP has been published (Clist, 2012). Within this catalogue explanations will be included to help the reader understand why a specific date has been put aside; or why it must be used with the utmost caution (the reader is referred to this catalogue as no further critical discussion can be advanced within the scope of this paper).

The maps in Figs. 1-6 show the geographical dispersal of those archaeological sites which show evidence of iron smelting, associated to calibrated time frames **(1)**:

- before 500 BC: iron smelting is known in western Centrafrique, perhaps also to the north-east of Yaoundé in Cameroon at Zili and in Rwanda/Burundi on some rare sites (Fig. 1);
- between 500 and 400 BC: iron smelting centers are set up in Centrafrique, in and around Yaoundé (Cameroon **(2)**), in Rwanda/Burundi and in Gabon at Moanda (Fig. 2). The extension of iron smelting to the south was likely made possible by the dry climatic spell which opened up savannah corridors through the equatorial forest and caused heavy forest fragmentation around 650 BC (see Clist, 2006a; Maley, 2004; and Fig. 7); coupled with the still open environment and the presence of communities of villagers, who settled in the western parts of the equatorial forest and throughout south-east Gabon. Settled from 1200 cal BC in southern Cameroon (Obobogo site at Yaoundé) the successive waves of advance of these peoples can be traced to Gabon, where the earliest evidence is today dated to 600-500 BC with the Okala Tradition (Clist, 2005, 2006b). The Gabonese villagers had not been established in the savannahs of Haut Ogooué long before they discovered or were introduced to iron smelting.

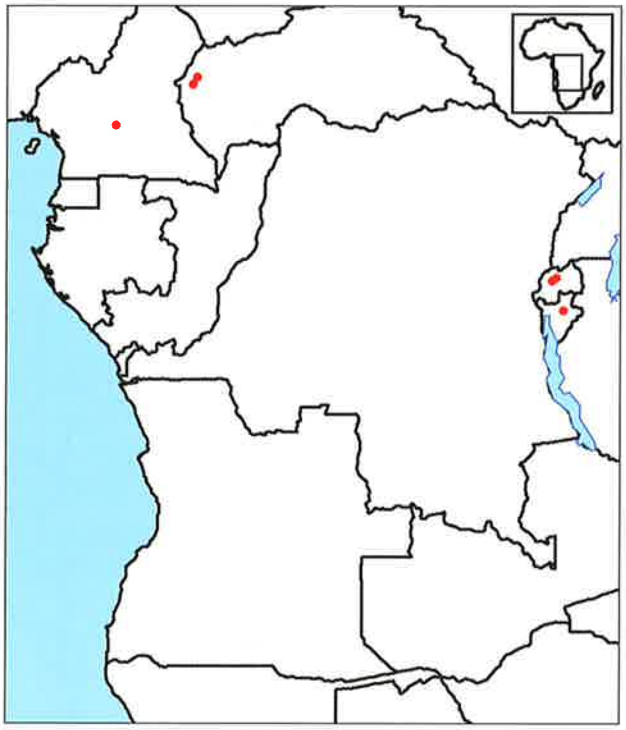

Figure 1: Iron smelting sites before 500 cal BC.

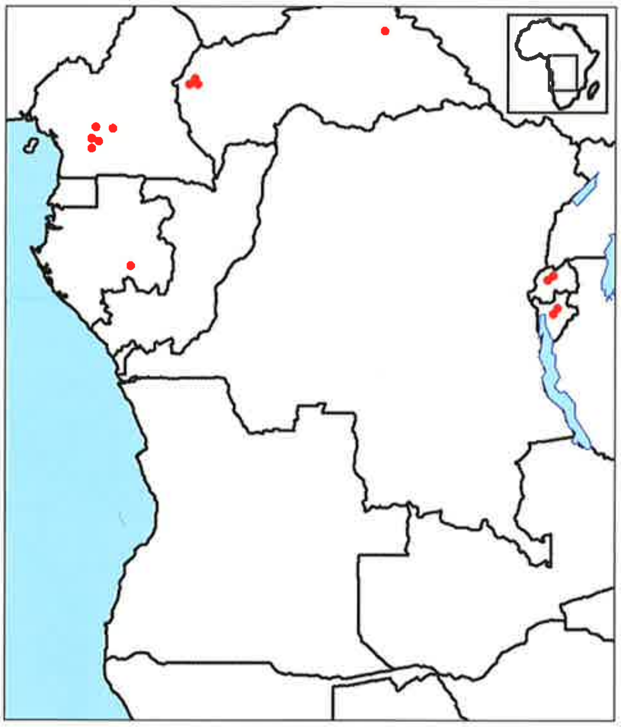

Figure 2: Iron smelting sites from 500 to 400 cal BC.

- 400 to 300 BC: other smelting sites have been found deep in the forests of southern Cameroon and northern Gabon (Fig. 3). The use of iron implements amongst Neolithic villagers was slowly becoming more widespread; perhaps some areas only imported iron implements based on economic ties established generations earlier
- 300 to 150 BC: iron smelting was still expanding to villages at this point and local production tended to be the general rule. Iron smelting became common along the Atlantic coast of Congo (Fig. 4);

- 150 BC to 100 AD: the metallurgists expanded to the Angolan border, the lower Congo and upstream along the major rivers of the Congo basin; deep into the equatorial forest (Figs. 5 and 6).

From Fig. 8, using the Gbabiri dates in Centrafrique (group B of dates), it is possible to infer that iron smelting started around c. 800 BC in the north-west of Central Africa (Zangato, 1999, 2007; Clist, 2005).

The Oboui site and other 3000 BP dates

The Oboui site excavations in Centrafrique have raised the possibility of the origin of iron smelting in Africa being significantly earlier than previous evidence has suggested. The calibrated plot of the six ^{14}C dates obtained for an early occurrence of iron working at that site has been set up against all other acceptable dates (Fig. 8). Excluding Pa-2196 (much younger), the remaining Oboui dates fall roughly between 2150-2000 cal BC (Fig. 8, group A); they are in strict isolation

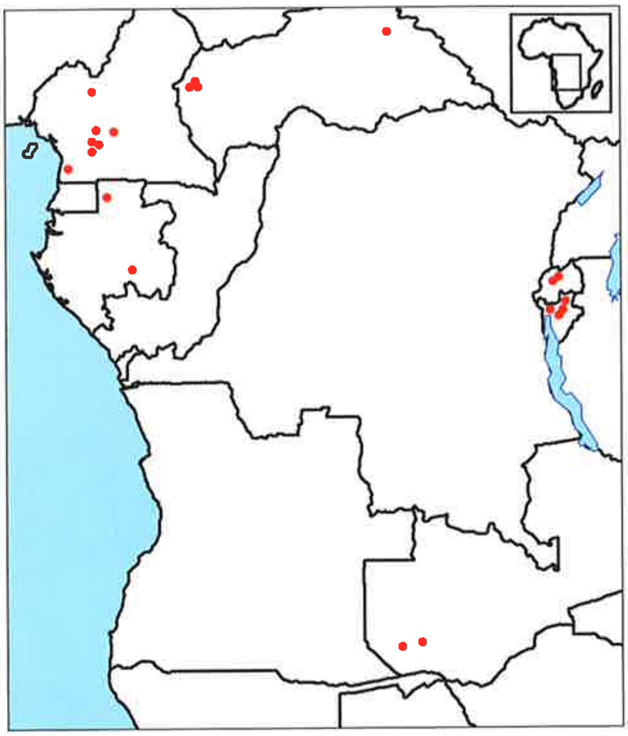

Figure 3: Iron smelting sites from 400 to 300 cal BC.

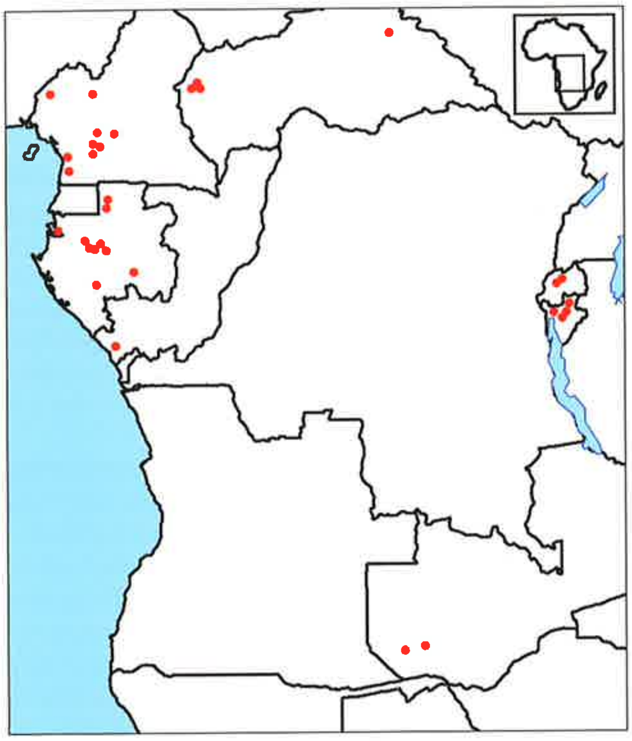

Figure 4: Iron smelting sites from 300 to 150 cal BC.

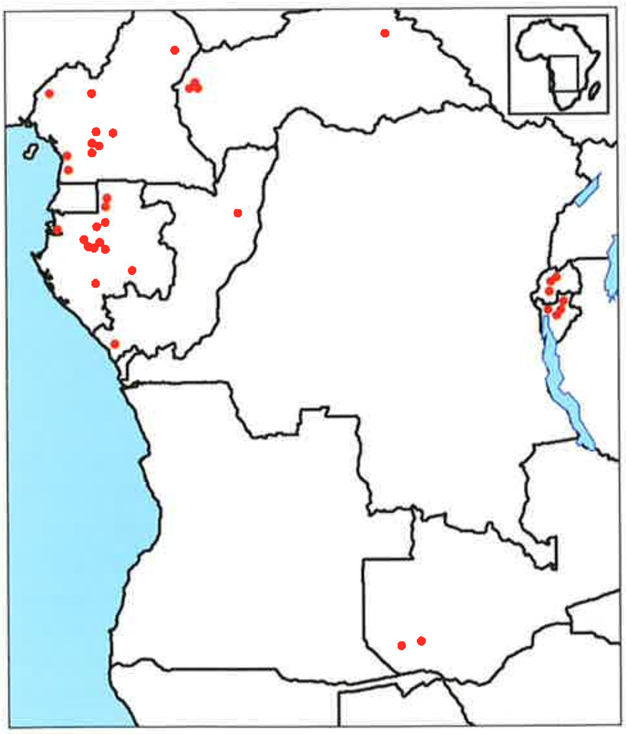

Figure 5: Iron smelting sites from 150 to 10 cal BC.

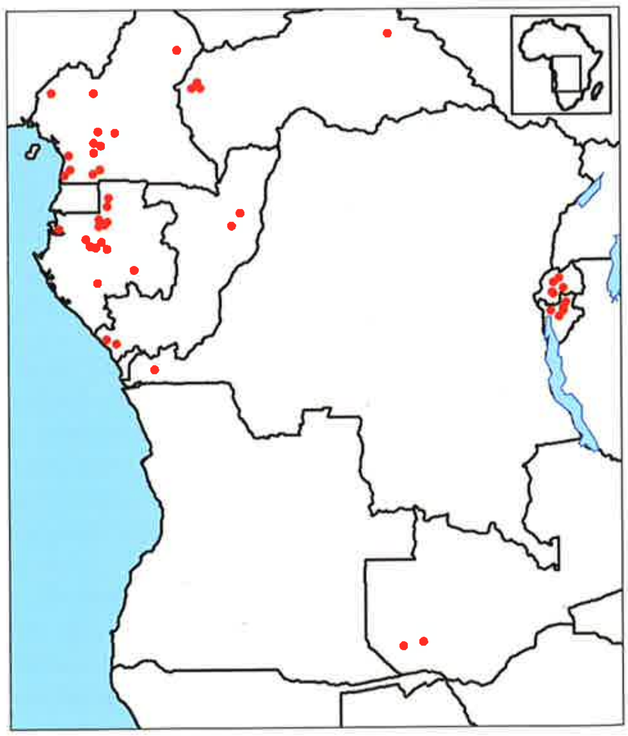

Figure 6: Iron smelting sites from 10 cal BC to 100 cal AD.

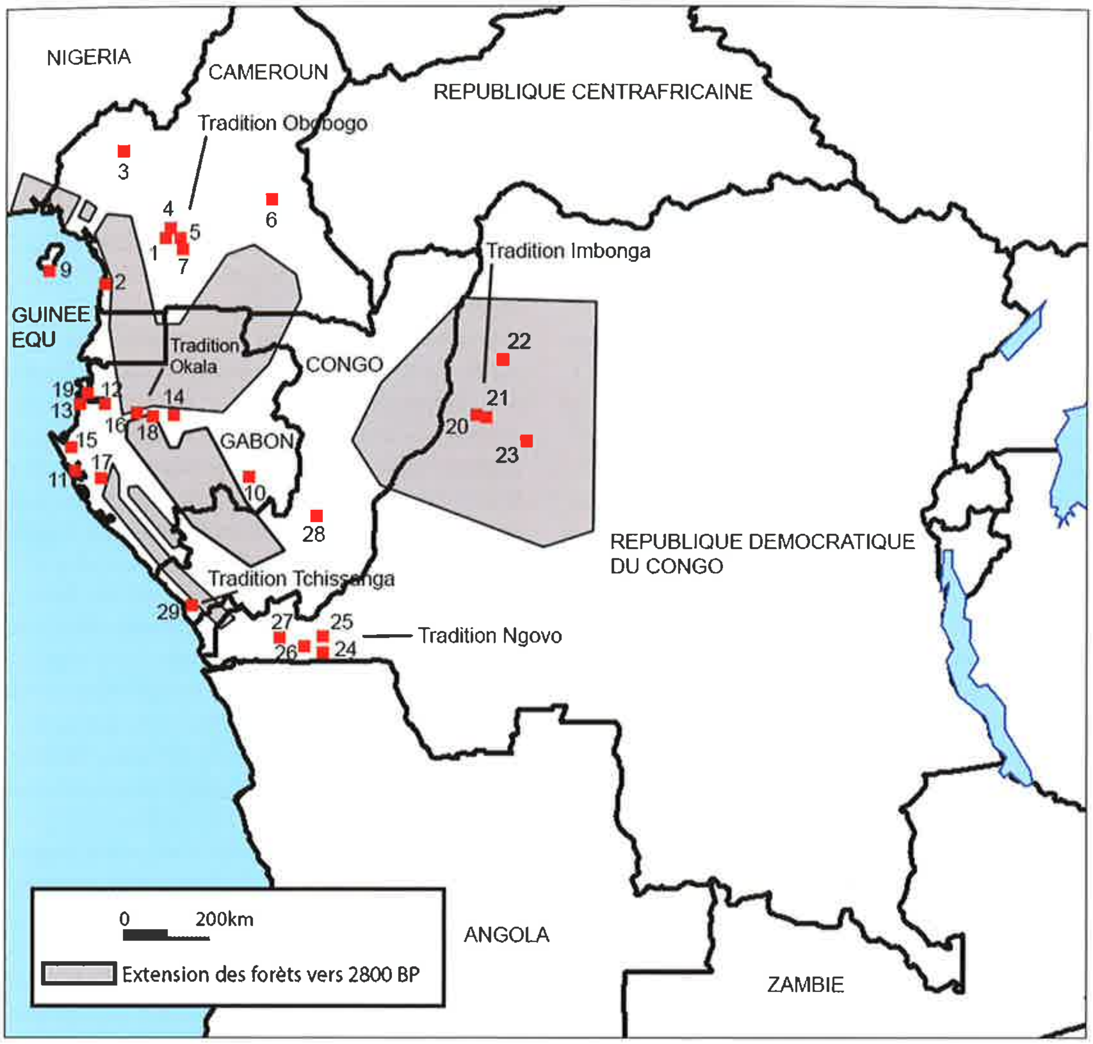

Figure 7: Theoretical extension of the western part of the equatorial forest around 3000 BP (greyed zones) and distribution map of the main villagers' traditions. (**see Note 3**)

from the rest of the corpus. Over 1000 cal years separate them from the earliest dates at Gbabiri, which lies only a few kilometres away (Fig. 8, group B).

Further c. 3000 BP dates within the bibliography of Central Africa have been investigated for comparison to the very early dates from Oboui; however, as several seminal questions on the Oboui excavation results remain unanswered (see Clist, 2012) and, due to the isolated nature of its calibrated dates, it seems pertinent for the time being to disregard the early c. 3600 BP 14C dates from the Oboui site.

The Lv-1880 3390+/-100 BP date from the Ogrotoulou cave in Centrafrique is one of a short series of fairly divergent dates coming from a single layer, 20cm thick, of mixed archaeological material. This single date must thus be used with caution (see Moga, 2008; Clist 2012). Other dates from the neighbourhood of Oboui have also been listed and all come from pre-*tazunu* layers at the Balimbé 2 site 68, Balimbé 2 site 21, and the Dokoko site 22 (Fig. 7). No iron artefacts or traces of iron production are associated to the dated samples (see Zangato, 1999, 2000, 2007, Zangato & Holl, 2010). Later, again from the Ogrotoulou cave, we have two ^{14}C dates which overlap around 2350 BP (Moga, 2008: Lv-1879, 2360±60 BP, and Lv-5948, 2350±50 BP).

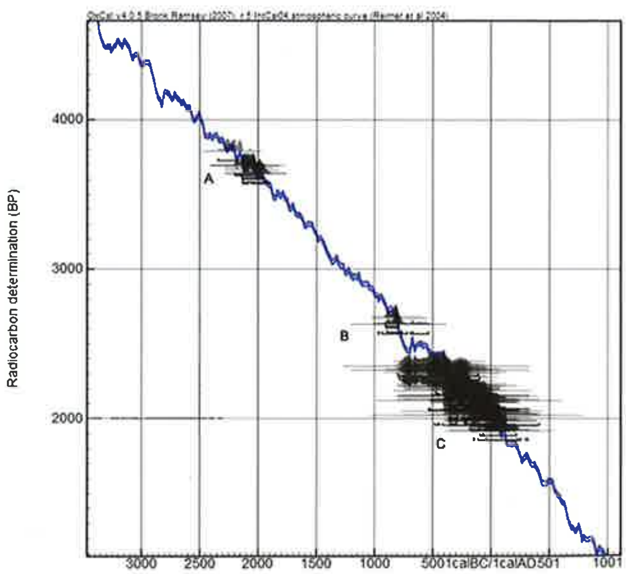

Figure 8: Calibrated dates for early iron smelting in Central Africa (using OxCal v.4.0.5).

In the south-east of the region, several dates from Rwanda and Burundi relate to this time range. One is referred to two papers by Belgian excavator Van Grunderbeek (Van Grunderbeek, 1992; Van Grunderbeek, et al., 2001), although all the 3000 BP dates have been discarded by her based on various considerations. The remaining "good" early ^{14}C dates are the following: Kabacusi Hv-121232815 +/- 165 BP, Gasiza 1 Hv-11143 2635 +/- 95 BP, Mirama 3a Hv-11142 2480 +/- 85 BP, Karuriye Hv-12925 2260 +/-110 BP, Rwiyange 1 Hv-12926 2250 +/- 125 BP, Muganza 1 Hv-12125 2245 +/- 65 BP, Rurembo GrN-5752 2180 +/- 50 BP, Mutwarubona 1 Ly-2267 2020 +/- 330 BP. All these dates fall between c. 2600 and 2000 BP. M.-C. Van Grunderbeek refers to the Kabacusi and Gasiza dates as evidence of the earliest stages of iron smelting in the Great Lakes area, excluding all the other earlier dated samples (Van Grunderbeek, et al., 2001, pp.276-277). In her account, it is the Gasiza 1 date which must be used to pinpoint the first known smelts (i.e. circa 750 cal BC).

At the Katuruka site in Tanzania, excavated by P. Schmidt, three early dates cluster around 2500 BP (N-895 2500 +/- 115 BP, RL-406 2470 +/- 110 BP, N-890 2400 +/- 115 BP) (see Clist, 1987). No other site is earlier than circa 600 cal BC.

No other dates from Central Africa are available in the 4000-3000 BP time range. To find similar alternative data it is necessary to turn to West Africa.

In Nigeria, at the Nsukka site, the earliest reported dates are 2305+/- 90 BP, 2170 +/- 80 BP, and 2080 +/- 90 BP (Okafor and Phillips, 1992; Okafor, 2004). By using the 2305 BP date, iron smelting in central Nigeria can be calibrated to around 400 cal BC. In Igboland, to the South-East, E. Okafor speaks of a circa 760 cal BC date. At the Lejja site, a single 4000 BP date on charcoal was obtained from charcoal imbedded in the crevices of an iron slag (Eje-Uzomaka **(4)**). Other ^{14}C dates from Lejja are earlier, although in all of these cases it is necessary to wait for the final site publication to understand the local context.

In Kano State in 1984, surveys led to thermoluminescence (TL) dating of three bowl furnaces (Darling, 1985). **(5)**. Both the Matafanda and Fitola sites are of very early origin. These results must be used cautiously however as they come from luminescence analyses carried out 25 years ago, after which time nothing else has been published about the sites' context. In addition, the dates of the bowl furnace sites are isolated.

In Burkina Faso, at Douroula, the earliest evidence for iron smelting is not earlier than 460 cal BC (Millogo, 2000, p.66).

In Senegal, amongst a small series of interesting archaeological sites, a deposit of iron tools and a few hints of local iron production on two mounds excavated at the site of Walaldé have produced calibrated dates between 800-200 BC (Deme and MacIntosh, 2006, pp.327-328 and 341-344). The earliest occupation phase appears to document a period of transitional iron use, with some worked stone in evidence (800-550 cal BC) (iron-using agropastoralists?). Smelting, forging slags and tuyères are in evidence in considerable quantities in the later phase (400-200 cal BC). It is possible to state that iron has been known there since at least 550 cal BC, as dated in the earliest levels.

In Mauritania, fieldwork carried out in 2000 dated one iron smelting furnace around 760-400 cal BC, or 582 cal BC (MacDonald et al., 2009, p.36; GX-30818-AMS 2440+/-40 BP).

Sadly, it has become fashionable over the last few years to use the ancient dating of metallurgical processes from the Termit area in Niger (Person et Quechon, 2001, 2004; Quechon, 2001, 2004) to support claims of autochthonous development of iron smelting (see for example Bocoum, 2004). Although contradicted by some (e.g. Killick, 2004; Alpern, 2005), the Niger data is still called upon to force the hypothesis of an independent development of iron technology in sub-Saharan Africa. G. Quéchon presented his position as follows: "... iron and copper objects appeared in Termit in approximately 1500 BC, and the first known smelting furnaces date from approximately 800 BC "(Quéchon, 2004, p.112). The major issues with Niger concern the quality of the ^{14}C dates and their degree of association to metallurgy. All the artefacts originate from unstratified settlements. They lie today on the surface of wind deflated sands. Even today, one can find up to "[...] 41 windy days on a 45 days fieldwork period" (Quéchon, 2001, p.248, translation B. Clist). An archaeologist who has specialised in West Africa, Anne Haour, has stated: "no definitive statement can be made on the occurrence of metal implements on surface settlements . . . other than to wish that these had been recovered in stratigraphically secure contexts. Skepticism . . . is the wisest approach" (Haour, 2003, pp.217-218).

The only more acceptable dataset for early metallurgy in Niger comes from the Do Dimmi 15 archaeological site, where some 22 iron smelting bowl furnaces were studied. Six radiocarbon dates bracket metallurgy between 3000 and 2000 BP (Quéchon, 1995, pp.310-311; Killick, 2004, p.104 and **(6)**). Once again however, the same stratigraphic problem outlined earlier for the Termit site is found here. At the time of the excavation, the excavators doubted the real association between the dated charcoal and the site itself (Quéchon and Roset, 1974, p.97). In addition, the regimented grouping of so many bowl furnaces in a relatively small area demonstrated by photographic documentation allegedly points to a short-lived episode rather than the far-ranging ^{14}C dates (Killick, 2004, p.105). One may add to this the fact that the oldest dates were obtained from the same laboratory, in Dakar.

Conclusion

It is now possible to suggest a circa 800 cal BC period when iron smelting may have started in Centrafrique and in Cameroon (Zili and Gbabiri sites). At 600 cal BC, iron tools were certainly produced locally in Cameroon at a small handful of sites. Iron in Centrafrique was not produced earlier than c. 500 cal BC.

Up to c. 1200 cal BC hunter-gatherers roamed the landscape; their material culture has enabled us to distinguish between several Late Stone Age industries (see Lanfranchi and Clist, 1991, Late Stone Age chapters for the latest synthesis). From 1200 to 400 cal BC, villagers settled the southern savannahs of Cameroon, the equatorial forest and, eventually, the northern regions of the savannahs south of this forest; a slow and irregular expansion of the Forest co-Traditions from North to South along the Atlantic coastline and inland through the forest block can be suggested (Clist, 2005, chap.8, pp.693-763). (Fig. 7). There existed a period when villagers used polished stone adzes and axes, cultivated small fields and relied heavily on oil palm and various other fruit trees. This is a genuine Neolithic culture.

From 600 to 400 cal BC, iron smelting began in places such as Zili in Cameroon and Moanda in Gabon, places which then exported finished iron products. Other centres were set up closer to those communities which already used iron tools (Figs. 1-7). During this transitional phase, when Neolithic villagers first acquired finished products from distant iron smelting specialists through already established trade routes, hunter-gatherer groups still existed. This aspect thus points toward a mosaic of interacting cultures which started to flourish around 3000 years ago in Central Africa and which persisted late into the Iron Age (Clist, 1991, 2006a, 2006b).

What then of the surrounding areas of Central Africa? Interestingly enough, iron was well established in the western Great Lakes area to the east, i.e. in Rwanda, Burundi, and west Tanzania around 600 cal BC. Moving to the north-west however, no clear picture of iron-smelting emerges. Central Nigeria has smelts going on from 400 cal BC onward, with the south-eastern region only showing evidence from around 760 cal BC. In Burkina Faso this is dated around 460 cal BC while in Senegal dates are known from around c. 550 cal BC, closer to those from south-eastern Mauritania, c. 580 cal BC one.

All of these dates from West and Central Africa fall within the 800-400 cal BC range, where a ^{14}C date can mean various things due to the discrepancies of the calibration scale and of the ^{14}C atmospheric contents, giving rise to a 400 years range. Some have called this period the "no date land" or "Hallstatt plateau" (Clist, 2005, pp.129-138).

Other evidence must be called for to differentiate contrasting data and to reinforce our paradigm. AMS dating **(7)**, wood identification of dated charcoals, detailed ceramic sequence of the excavated site, detailed analysis of other artefacts or ecofacts, detailed presentation of stratigraphic and spatial contexts of finds: all of these methods must now be systemically used to help us to resolve the debate about the origins and dating of iron metallurgy. Far more interestingly, they must be used to discern the differing social ways in which the forging and use of iron dispersed throughout the region came to be accepted and transformed by villagers. For the time being however, this remains wishful thinking, limited by the state of our data sets.

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Notes

1. Using "Online CalPal" at http://www.calpal-online.de/index.html. "Online CalPal" was used throughout this paper and especially for its conclusions.
2. None of the ^{14}C dates from the well-known Oliga site in Cameroon have been used in Figures 1-6 and 8. I discussed the data at length a few years ago (Clist, 2005, pp. 771-772). S. Alpern, reviewing the pros and cons of the origin of iron smelting in Africa, synthesised my standpoint on Oliga: "[B. Clist] believes the data come from what archeologists deem a 'secondary deposit', a a natural pit at the base of a hillside down which rain has washed remains of an iron-smelting furnace, including slag and tuyères, along with charcoal from various periods besides that of the furnace" (Alpern, 2005, pp.76-77).
3. Cameroon - 1: Avoh, 2: Kribi (sites of Bwambé, Eboundja, Malongo), 3: Njinikejem, 4: Nkang, 5: Nkométou, 6: Ouélé Maroua, 7: Yaoundé (sites of Ndindan, Obobogo, Okolo); Centrafrique – 8: Balimbé ; Equatorial-Guinea – 9: Bioko island; Gabon – 10: Franceville, 11: Ikengué, 12: Kango, 13: Libreville (sites of Okala, Cap Estérias), 14: Lopé (sites of Lopé 2, Lopé 12, Okanda 1, Okanda 6, Toubé 1), 15: Mbilapé, 16: Ndjolé, 17: Ofoubou (sites of Ofoubou 5, Ofoubou 16), 18: Otoumbi 13, 19: Rivière Denis; Democratic Republic of Congo – 20: Bokele, 21: Bokuma, 22: Boso Njafo, 23: Imbonga, 24: Kwimba, 25: Ngovo/Dimba, 26: Ntadi Ntadi, 27: Sakuzi; Congo – 28: Djambala, 29: Tchissanga et Tandou Youmbi.
4. See Ezo-Uzomaka, communication at the SAFA meeting in Frankfurt, Germany, 8-11 September 2008: http://cohesion.rice.edu/centersandinst/safa/emplibrary/AlphabeticalProceedings2008.pdf
5. Roni site: DurTL-45-2AS , 380 +/- 320 AD; Matafanda site: DurTL-57-3AS, 1400 +/- 50 BC; Fitola site: DurTL-57-2AS, 2400 +/- 1100 BC (Darling, 1985).
6. Do Dimni 15: Dak-147: 2924 +/- 120 BP; Dak-145: 2628+/- 120 BP; Pa-288: 2500 +/- 70 BP; UPS-?: 2065 +/- 60 BP.
7. A new dating method entailing the dating of ceramics by way of their progressive building up of water contents (rehydroxylation dating) - still in its experimental stage - may lead to major breakthroughs in Sub-Saharan Africa. See for example Wilson et al. (2009).

References

Alpern, S.B., 2005. Did they or didn't they invent it? Iron in Sub-Saharan Africa. *History in Africa*, 32, pp.41-94.

Anciaux de Faveaux, A. and Maret, P. de, 1984. Premières datations pour la fonte du cuivre au Shaba (Zaïre). *Bulletin de la Société Royale Belge d'Anthropologie et de Préhistoire*, 95, pp.5-20.

Bocoum, H. ed., 2004. *The origins of Iron Metallurgy in Africa: new light on its antiquity*. Paris: UNESCO.

Clist, B., 1987. A critical reappraisal of the chronological framework of Urewe Early Iron Age Industry. *Muntu*, 6, pp.35-62.

Clist, B., 1989a. Bilan des premiers travaux du Département d'Archéologie du CICIBA: missions du premier semestre 1985. In: *Actes du colloque international "les peuples bantu, migrations, expansion et identité culturelle", Libreville, 1-6 Avril 1985, Vol.1*. Paris: L'Harmattan/CICIBA, pp.103-10.

Clist, B., 1989b. Archaeology in Gabon, 1886-1988. *The African Archaeological Review*, 7, pp.59-95.

Clist, B., 1991. Synthèse régionale sur l'Age du Fer Ancien. in Lanfranchi, R. and Clist, B. eds. *Aux origines de l'Afrique Centrale*. Ministère de la Coopération et du Développement / Centre Culturel français de Libreville / Sépia, Paris, pp.225-226.

Clist, B., 1995. *Gabon: 100.000 ans d'Histoire*. Paris: Centre Culturel français Saint-Exupéry / Sépia.

Clist, B., 1997. Le site d'Okala, Province de l'Estuaire, Gabon et son importance pour la compréhension du passage à la sédentarisation en Afrique Centrale. *Comptes rendus de l'Académie des Sciences de Paris, série Sciences de la terre et des planètes*, 325, pp.151-6.

Clist, B., 2005. *Des premiers villages aux premiers européens autour de l'estuaire du Gabon: quatre millénaires d'interactions entre l'homme et son milieu*. PhD Thesis, Université Libre de Bruxelles.

Clist, B., 2006a. Mais où se sont taillées nos pierres en Afrique Centrale entre 7.000 et 2.000 bp? In: H.-P. Wotzka, ed. *Grundlegungen. Beiträge zur europäischen und afrikanischen Archäologie für Manfred K.H. Eggert*. Tübingen: Francke Attempto Verlag GmbH and Co. KG, pp.291-302.

Clist, B., 2006b. Coexistences matérielles entre 6000 et 20 cal BC en Afrique centrale: une mosaïque culturelle. In: L. Astruc, F. Bon, V. Lea, P.-Y. Milcent and S. Phillibert eds. *Normes techniques et pratiques sociales. De la simplicité des outillages pré- et protohistoriques, XXVIe rencontres internationales d'archéologie et d'histoire d'Antibes*. Antibes: Editions APDCA, pp.377-83.

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.

Clist, B., Oslisly, R. and Peyrot, B., 1986. La métallurgie du fer au Gabon: premiers éléments de synthèse. *Muntu*, 4-5, pp.47-55.

Darling, P., 1985. Fieldwork surveys in and around Kano State, Nigeria, 1982-1985. *Nyame Akuma*, 27, pp.39-41.

David, N., 1980. Early bantu expansion in the context of Central African prehistory: 4000-1 BC. In: L. Bouquiaux ed. *L'expansion bantoue (= Actes du Colloque international du CNRS, Viviers, France, 1977), Vol. II*. Paris: SELAF, pp.609-47.

Deme, A. and McIntosh, S.K., 2006. Excavations at Walaldé: new light on the settlement of the Middle Senegal Valley by iron-using peoples. *Journal of African Archaeology*, 4(2), pp.317-47.

Digombe, L., Schmidt, P., Locko, M., Mouleingui Boukossou, V. and Mombo, J.B., 1985. Radiocarbon dates for the Iron Age in Gabon. *Current Anthropology*, 26(4), p.516.

Digombe, L., Schmidt, P., Mouleingui Boukossou, V., Mombo, J.B. and Locko, M., 1987. L'Age du Fer Ancien au Gabon. *L'Anthropologie*, 91(2), pp.711-7.

Haour, A., 2003. One Hundred Years of Archaeology in Niger. *Journal of World Prehistory*, 17, pp.217-8.

Killick, D., 2004. Review essay: what do we know about African iron working? *Journal of African Archaeology*, 2(1), pp.97-112.

Lanfranchi, R. and Clist, B. eds., 1991. *Aux origines de l'Afrique Centrale*. Paris: Centers Culturels français d'Afrique Centrale/ CICIBA.

MacDonald, K.C., Vernet, R., Martinon-Torres, M. and Fuller, D., 2009. Dhar Néma: from early agriculture to metallurgy in southeastern Mauritania. *Azania: archaeological research in Africa*, 44(1), pp.3-48.

Maley, J., 2004. Les variations de la végétation et des paléoenvironnements du Domaine Forestier africain au cours du Quaternaire récent. In: J. Renault-Miskovsky and A.M. Semah, eds. *L'évolution de la Végétation depuis deux millions d'années*. Paris: Publications Artcom - Errance, pp.143-78.

Maret, P. de, 1978. *Chronologie de l'âge du fer dans la dépression de l'Upemba en République du Zaïre*. PhD Thesis manuscript, Université Libre de Bruxelles.

Maret, P. de, 1982. New survey of archaeological research and dates from West-Central and North-Central Africa. *Journal of African History*, 23, pp.1-15.

Maret, P. de, 1985. Recent archaeological research and dates from Central Africa. *Journal of African History*, 26(2-3), pp.129-48.

Maret, P. de, Van Noten, F. and Cahen, D., 1977. Radiocarbon dates from West Central Africa: a synthesis. *Journal of African History*, 18(4), pp.481-505.

Millogo, A.K., 2000. Les premières métallurgies. In: R. Vernet, ed. *L'archéologie en Afrique de l'Ouest*. Saint Maur: Editions Sépia, pp.59-70.

Moga, J., 2008. La métallurgie du fer en Centrafrique: premiers éléments de synthèse. *Revue Centre Africaine d'Anthropologie*, 1, pp.1-9.

Okafor, E.E., 2004. Twenty-five centuries of bloomer iron smelting in Nigeria. In: H. Bocoum, ed. *The origins of Iron Metallurgy in Africa: new light on its antiquity*. Paris: UNESCO, pp.43-54.

Okafor, E.E. and Phillips, P., 1992. New 14C ages from Nsukka, Nigeria and the origins of African metallurgy. *Antiquity*, 66, pp.686-8.

Person, A. and Quechon, G., 2001. Données chronométriques et chronologiques de la métallurgie du fer à Termit: matériaux graphiques pour l'étude des Ages anciens du fer. *Mediterranean Archaeology*, 14, pp.255-62.

Person, A. and Quechon, G., 2004. Chronometric and chronological data on metallurgy at Termit: graphs for the study of the ancient Iron Ages. In: H. Bocoum, ed. *The origins of Iron Metallurgy in Africa: new light on its antiquity*. Paris: UNESCO, pp.119-26.

Quechon, G., 1995. La fin du néolithique et les débuts de la métallurgie dans le massif de Termit (Niger): éléments de méthodologie. In: A. Marliac, ed. *Milieux, sociétés et archéologues*. Paris: ORSTOM-Karthala, pp.303-12.

Quechon, G., 2001. Les datations de la métallurgie du fer à Termit (Niger): leur fiabilité, leur signification. *Mediterranean Archaeology*, 14, pp.247-53.

Quechon, G., 2004. Iron metallurgy datings from Termit (Niger): their reliability and significance. In: H. Bocoum, ed. *The origins of Iron Metallurgy in Africa: new light on its antiquity*. Paris: UNESCO, pp.109-18.

Quechon, G. and Roset, J.-P., 1974. Prospection archéologique du massif de Termit (Niger). *Cahiers ORSTOM, série Sciences Humaines*, 11(1), pp.85-104.

Schmidt, P., Digombe, L., Locko, M. and Mouleingui, V., 1985. Newly dated Iron Age sites in Gabon. *Nyame Akuma*, 26, pp.16-8.

Van Grunderbeek, M.-C., 1992. Essai de délimitation chronologique de l'Age du Fer Ancien au Burundi, au Rwanda et dans la region des Grands Lacs. *Azania*, 27, pp.53-80.

Van Grunderbeek, M.-C., Roche, E. and Doutrelepont, H., 2001. Un type de fourneau de fonte du fer associé à la culture Urewe (Age du Fer Ancien), au Rwanda et au Burundi. *Mediterranean Archaeology*, 14 (= *Proceedings of the First International Colloquium on the archaeology of Africa and the Mediterranean basin held at the Museum of Natural History in Geneva, 4-7 June 1999*), pp.271-97.

Wilson, M.A., Carter, M.A., Hall, C., Hoff, W.D., Ince, I., Savage, S.D., McKay, B. and Betts, I.M., 2009. Dating fired-clay ceramics using long-term power law rehydroxylation kinetics. *Proceedings of the Royal Society* (A), 465(2108), pp.2407-15.

Wotzka, H.-P., 2006. Records of activity: radiocarbon and the structure of Iron Age settlement in Central Africa. In: H.-P. Wotzka, ed. *Grundlegungen. Beiträge zur europäischen und afrikanischen Archäologie für Manfred K.H. Eggert*, Tübingen: Francke Attempto Verlag GmbH and Co. KG, pp.271-89.

Zangato, E., 1999. *Sociétés préhistoriques et mégalithes dans le Nord-Ouest de la République Centrafricaine*, Cambridge Monographs in African Archaeology 46, British Archaeological Reports International Series 768. Oxford: Archaeopress.

Zangato, E. 2000. *Les occupations néolithiques dans le Nord-Ouest de la République centrafricaine*. Collection Préhistoires, Volume 3, Éd. M. Mergoil, Montagnac.

Zangato, E., 2007. *Les ateliers d'Oboui. Premières communautés métallurgistes dans le nord-ouest du Centrafrique*. Paris: Editions Recherche sur les Civilisations.

Zangato, E. and Holl, A.F.C. 2010. On the Iron Front: New Evidence from North-Central Africa. *Journal of African Archaeology*, 8 (1), pp.7-23.

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