Two Late Iron Age charcoal kilns from the Arlon forest (Arlon, province of Luxemburg, Belgium)

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1. Introduction

In 2017, an evaluation of the archaeological potential was done of an area in the domain of the Arlon forest where a new golf course was planned, 7 km south-west from Arlon (Collette *et al*. in press). No archaeological features have been found during this evaluation, although previous finds of Mesolithic and Neolithic age have been reported from sites in the close proximity, i.e. in the sandy part of the military zone of Lagland (Noël 1977). In addition, an ancient land parcel was identified on LIDAR images of the south of the domain and a probable iron oxide exploitation in the southwestern part of the area.

Early 2018, some small trial trenches were dug by the AWaP in an area that showed high values of phosphates. In these trenches, two large pits have been found that date to the late Iron Age (fig. 1).

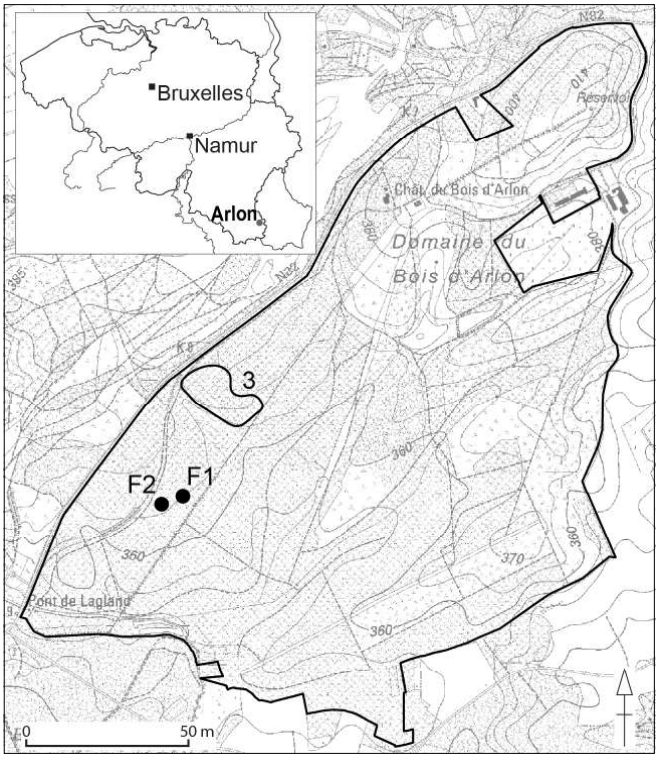

Fig. 1. Delimitation of the domain of "Bois d'Arlon" and location of the two pits (F1 & F2) in the domain ; 3 : zone of relief anomalies and presence of iron rich minerals (Infography S. Leduc, AWaP).

2. Description of the pits

Both pits contained nothing but charcoal and sediment and were situated 68 metres apart from each other.

The first pit (pit 1/F1) had a rectangular outline (in horizontal plane) with rounded corners. It measured 3,76 x 1,8 m and had a depth of ca. 55 cm. It had a nearly flat bottom except for the eastern part, where the bottom shows a depression of ca. 50 cm diameter with a depth of 15 cm (fig. 2). The bottom of the pit showed locally signs of rubification (fig. 2, layer 4) visible as a layer of reddish loam up to 3 cm thick. The lower part of the fill consists of a layer of nothing but charcoal fragments, with a thickness of ca. 5 cm at the centre and which increases up to 15 cm towards the sides of the pit (fig. 2, layer 3). On top of this charcoal layer, there was a layer of yellow and grey loam mixed with charcoal fragments and ash (fig. 2, layer 2). The upper part of the fill consists of a layer of dark brown clay loam with ash, charcoal and chunks of rubified loam (fig. 2, layer 1).

The second pit (pit 2/F2) was situated to the west of pit 1 and showed an orientation perpendicular to it. The pit had an oval outline (in horizontal plane), measuring 2,58 x 1,6 m with a depth of 35 cm. The base of the pit, especially the northern part, showed signs of rubification, up to a few cm depth. Also the sides of the pit showed some signs of rubification. Its fill was more homogeneous compared to pit one, very dark coloured and rich in charcoal.

3. Charcoal analysis

From each of the two pits, bulk samples from the charcoal were sieved (mesh size 0,5 mm) and the sieved residues were air-dried for one week. From each of the dried residues, a minimum of 100 charcoal fragments were randomly selected, independent of their size. These fragments were identified using a microscope with incident dark field illumination and following standardised procedures (Gale & Cutler 2000). Identifications are based on wood anatomy identification literature (Schweingruber 1990; Schoch *et al*. 2004) and the anthracological reference collection of the Royal Belgian Institute of Natural Sciences.

All studied charcoal fragments (pit 1: n=106; pit 2: n=103) have been identified as oak (*Quercus* sp.). Except for one fragment which was a piece of a charred twig, all analysed

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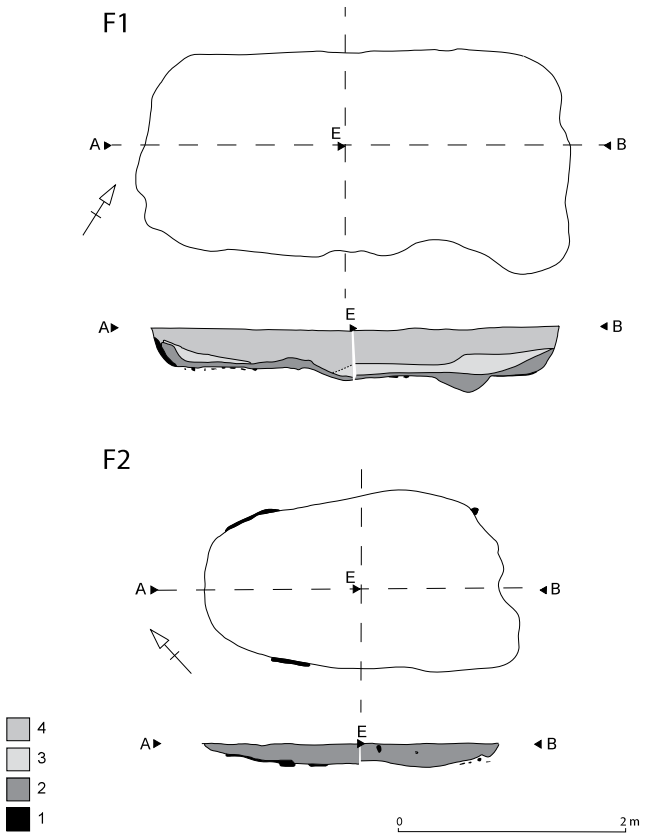

Fig. 2. Plan and section of charcoal kilns (Infography M.-N. Rosière & S. Leduc, AWaP).

charcoal fragments showed straight growth ring boundaries, indicating that these came from stems and branches with a large diameter.

4. Radiocarbon dating

From each of the two pits, a charcoal fragment has been dated by radiocarbon analysis, performed at the Royal Institute for Cultural Heritage in Brussels. The samples were selected in order to avoid a possible old wood effect, i.e. a fragment of charred sapwood from pit 1 and a charred twig from pit 2, both oak (table 1). All dates were calibrated with OxCal 4.3.2 (Bronk Ramsey 2009) using the Intcal13 calibration curve (Reimer *et al*. 2013).

The radiocarbon analysis resulted in a date of 2146 ± 26 uncal BP for pit 1 and 2118 ± 26 uncal BP for pit 2. Calibration of these dates results in an age probability distribution between 355 BC and 292 BC (24.9%) or between 231 BC and 91 BC (70.5%) for pit 1 and between 334 BC and 330 BC (0.6%) or between 204 BC and 52 BC (94.8) for pit 2 (fig. 3).

5. Interpretation

The two excavated pits in the Arlon forest show a lot of similarities with other pits that recently have been excavated in NW Europe and that have been interpreted as charcoal pit-kilns, structures that were used for the production of charcoal. These pits are all shallow pits with a flat bottom and straight vertical sides and have a charcoal layer at the base of their fill. Other characteristics are the absence of both animal and human bone, ceramics and other artefacts, and thermally induced rubification of the surrounding sediment along the bottom and sides of the pit (e.g. Groenewoudt 2005, 2007; Groothedde 2013; Marinova & Deforce 2014; Deforce *et al*. 2015, 2017; in press; Danese 2015). Almost all pit-kilns dating to the Iron Age, Roman and Early Medieval period have a rectangular outline and pit-kilns dating to the high medieval period show a circular outline (Groenewoudt 2007; Deforce *et al*. in press). From ca. 1200 AD onwards, charcoal production was done in above ground mound kilns (e.g. Deforce *et al*. 2013).

Another common characteristic of charcoal kilns is the (almost) monospecific charcoal assemblage of their fill, with mostly oak (*Quercus* sp.) or sometimes beech (*Fagus sylvatica*) being to single or very dominant wood taxon (Marinova & Deforce 2014; Deforce *et al*. 2015, 2017; in press, Gasc *et al*. 2018). This is most likely the consequence of selection of wood species that produce high quality charcoal, especially as most of the charcoal produced in these kilns must have served as fuel for iron melting, a process which requires high temperatures (Gale 2003).

There are very few finds of Iron Age charcoal kilns up to know and all of these date to the Late Iron Age. In Belgium, there are some Iron Age pit kilns that have been found in Roeselare and Staden (Beke *et al*. 2017; Vanhoutte 2018) . In the Netherlands, Iron Age pit kilns are known from Anloo and Heeten (Groenewoudt 2005; Van der Velde 2007). In France, Iron Age pit kilns have been excavated in Saint-Martin-d'Ary (Charante-Maritime), Enversin (Rhône) and Ille-et-Villaine (Mans) (Gasc et al. 2018; Lurol & Cabanis 2012; Vivet 2007).

6. Conclusion

There are many remains of mound kilns present in the Arlon forest, but these probably all date to the end of the 18th cen-

Feature	Sample	Lab-code	Age (uncal BP)	Age (cal BC, 2 σ-range)
pit 1	oak (*Quercus* sp.) charcoal (sapwood)	RICH-26376	2146 ± 26	355 (24.9%) 292 231 (70.5%) 91
pit 2	oak (*Quercus* sp.) charcoal (twig)	RICH-26377	2118 ± 26	334 (0.6%) 330 204 (94.8) 52

Table 1. Results of the radiocarbon analysis. Calibrations were done with OxCal v4.3 Bronk Ramsey (2009) using the IntCal13 atmospheric curve (Reimer et al*. 2013).*

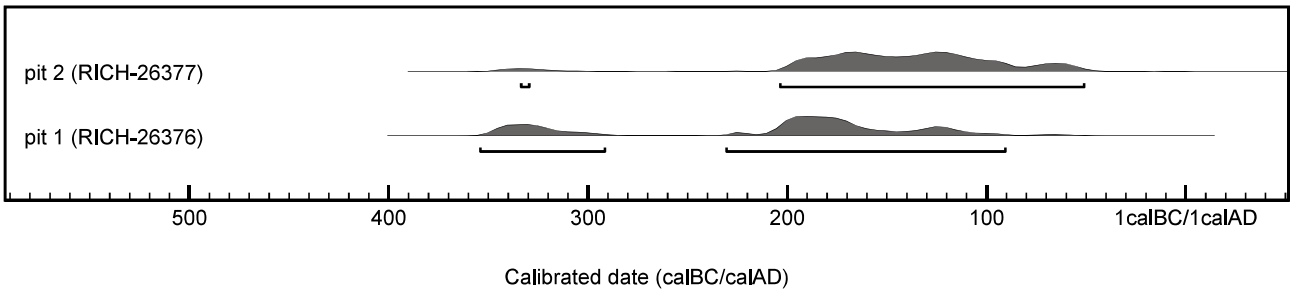

Fig. 3. Multiplot with calibrated age distributions (95,4% probability range) of pit 1 and 2 from the Arlon forest (OxCal v4.3 Bronk Ramsey (2009); IntCal13 atmospheric curve (Reimer et al*. 2013)).*

tury, when iron was already produced on an industrial scale in the region, but before the largescale exploitation of fossil coal (Hardy & Dufey 2015). Relief anomalies observed on LIDAR images of the southwestern part of the domain of the Arlon forest (fig. 1. 3) coincidence with the superficial occurrence of iron rich minerals which are known to have been exploited in the region at least from the 17th century onwards (Denayer 2011).

The two probable charcoal pit-kilns described above now indicate that iron production in the region might have started already during the Late Iron Age, although the remains of low furnaces, which were used for iron production during the Iron Age, have not been found.

Late Iron Age sites and structures are rare in general in the southern part of the province of Luxemburg, and the most frequent are remains of fortifications and funerary sites. The two probable charcoal production kilns are the first indications for artisanal activities during the Late Iron Age in the region.

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Bibliography

BEKE, F., VAN DEN DORPEL, A. C. & CLAUS, A. 2017: *Archeologisch onderzoek langs het Fluxys tracé Alveringem - Maldegem. Archeologisch onderzoek lot 4: Deelzone Poperinge - Lo-Reninge en Staden*. Unpublished report

BRONK RAMSEY, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon,* **51**, pp. 337-360.

COLLETTE, O., DRAILY, C. & SPAGNA, P. in press. Arlon/ Toernich : sondages dans le Domaine du Bois d'Arlon. *Chronique de l'Archéologie wallonne*, **26**, pp. 163-167.

DANESE, V. 2015. Des fosses de charbonniers romaines dans la zone d'activité économique d'Ath/Ghislenghien IV. *Signa*, **4**, pp. 47-52.

DEFORCE, K, VANMONTFORT, B. & VANDEKERKHOVE, K. in press. Early and High Medieval (c. 650 AD–1250 AD) Charcoal Production and Its Impact on Woodland Composition in the Northwest-European Lowland: A Study of Charcoal Pit Kilns from Sterrebeek (Central Belgium). *Environmental Archaeology*, (https://doi.org/10.1080/14614103.2018.1538087)

DEFORCE, K. & BOEREN, I. 2009. Anthracologisch onderzoek. In: P. LALOO, W. DE CLERCQ, Y., PERDAEN & PH. CROMBÉ (eds), *Het Kluizendokproject. Basisrapportage van het preventief archeologisch onderzoek op de wijk Zandeken (Kluizen, gem. Evergem, prov. Oost-Vlaanderen)*, UGent Archeologische Rapporten **20**. Gent : Universiteit Gent, pp. 70-93.

DEFORCE, K., BOEREN, I., ADRIAENSSENS, S., BASTIAENS, J., DE KEERSMAEKER, L., HANECA, K., TYS, D. & VANDEKERKHOVE, K. 2013. Selective woodland exploitation for charcoal production. A detailed analysis of charcoal kiln remains (ca. 1300-1900 AD) from Zoersel (Northern Belgium). *Journal of Archaeological Science*, **40**, pp. 681-689.

DEFORCE, K., MARINOVA, E. & DALLE, S. 2015. Vijf Romeinse houtskoolbranderskuilen in Emblem (Ranst, prov. Antwerpen). *Signa*, **4**, pp. 75-79.

DEFORCE, K, DE CLERCQ, W., HOORNE, J., LALOO, P., BOUDIN, M., VANSTRYDONCK, M. & CROMBÉ, PH. 2017. Anthracologisch onderzoek en radiokoolstofdatering van Romeinse houtskoolbranderskuilen uit Rieme (Evergem, prov. Oost Vlaanderen). *Signa*, **6**, pp. 27-32.

DENAYER, J., PACYNA, D. BOULVAIN, F. 2011. *Le Minerai de fer en Wallonie*. Jambes : DGARNE.

GALE, R. 2003. Wood-based industrial fuels and their environmental impact in lowland Britain. *In*: P. MURPHY & P. E. J. WILTSHIRE (eds), *The environmental archaeology of industry*. Symposia of the Association for Environmental Archaeology 20. Oxford Books: Oxford, pp. 30-47.

GALE, R. & CUTLER, D.F. 2000. *Plants in archaeology: identification manual of vegetative plant materials used in Europe*

and the Southern Mediterranean to c. 1500. Kew: Westbury and Royal Botanic Gardens.

GASC, J., BELLINGARD, CH. & RASSAT, G. 2018. Les charbonnières et l'activité métallurgique du site "le Noret" à Saint-Martin-d'Ary (Charante-Maritime). *In* : S. PARADIS-GRENOUILLET, S. BURRI & R. ROUAUD (EDS), *Charbonnage, charbonnières, charbonniers. Confluence de regards autour d'un artisanat méconnu*. Aix-en-Provence: Presse Universitaire de Provence, pp. 13-22.

GROENEWOUDT, B. J. 2005. Sporen van Houtskoolproductie en Landschapsdynamiek in een Verdwenen Bos bij Anloo. *Nieuwe Drentse Volksalmanak,* **122**, pp. 152-162.

GROENEWOUDT, B. J. 2007. Charcoal Burning and Landscape Dynamics in the Early Medieval Netherlands. *In*: J. KLÁPŠTĚ & P. SOMMER (eds), *Arts and Crafts in Medieval Rural Environment*, Ruralia **VI**. Turnhout: Brepols publishers, pp. 327-337.

GROOTHEDDE, M. 2013. Charcoal and Iron Production at and around Zutphen (ad 850–1200). *Medieval and Modern Matters*, **4**, pp. 61-80.

HARDY, B. & DUFEY, J. 2015. La forêt wallonne, composante vitale de la sidérurgie préindustrielle. *Forêt-Nature*, **135**, pp. 10-18.

LUROL, J. M. & CABANIS, M. 2013. Deux charbonnières gallo-romaines en grandes fosses, à Enversin sur la commune de Joux (Rhône). *In* : A. DECAULNE (éd.), *Colloque international Arbres et Dynamique*. Clermont-Ferrand : Presses Universitaires Blaise Pascal, pp. 129-153

MARINOVA, E. & DEFORCE, K. 2014. Anthracologisch onderzoek van houtskoolbranderskuilen. *In*: B. VAN DER VEKEN (ed.), *Veldhoven, Zilverackers. Archeologisch onderzoek ter plaatse van de Westelijk Ontsluitingsroute (fase 1)*, ADC rapport 3562. Amersfoort: ADC, pp. 201-206.

NOËL, J. 1977. Le mésolithique de Lagland. *Archaeologia Belgica*, **200**, pp. 5-40.

REIMER, P.J., BARD, E., BAYLISS, A., BECK, J.W., BLACKWELL, P.G., BRONK RAMSEY, C., BUCK, C.E., CHENG, H., EDWARD, R.L., FRIEDRICH, M., GROOTES, P.M., GUILDERSON, T.P., HAFLIDASON, H., HAJDAS, I., HATTÉ, C., HEATON, T.J., HOFFMANN, D.L., HOGG, A.G., HUGHEN, A., KAISER, KK.F., KROMER, B., MANNING, S.W., NIU, M., REIMER, R.W., RICHARDS, D.A., SCOTT, E. M., SOUTHON, J.R., STAFF, R.A., TURNEY, C.S.M. & VAN DER PLICHT, J. 2013. INTCAL13 and MARINE 13 Radiocarbon age calibration curves 0–50,000 YEARS CAL BP. *Radiocarbon*, **55**, pp. 1869–1887.

SCHOCH, W., HELLER, I., SCHWEINGRUBER, F. H. & KIENAST, F. 2004. *Wood anatomy of central European Species*. Online version: www.woodanatomy.ch.

SCHWEINGRUBER, F. H. 1990. *Microscopic wood anatomy: Structural variability of stems and twigs in recent and subfossil woods from Central Europe*. Birmensdorf: WSL.

VAN DER VELDE H.M. 2007. *Germanen, Franken en Saksen in Salland. Archeologisch en landschappelijk onderzoek naar de geschiedenis van het landschap en nederzettingsresten uit de Romeinse tijd en Vroege Middeleeuwen in Centraal Salland*, ADC Monografie 1. Amersfoort: ADC

VANHOUTTE, CH. 2018. *Archeologische opgraving Roeselare Honzebrouckstraat (prov. West-Vlaanderen). Verslag van resultaten opgraving*. Ingelmunster: Monument Vandekerckhove nv. (unpublished report).

VIVET, J. B. 2004. La production du fer protohistorique en haute Bretagne d'après les résultats des prospections, des fouilles d'ateliers et des analyses archéométriques. *In* : P.-Y. MILCENT (dir.), *L'économie du fer protohistorique: de la production à la consommation du métal*, actes du XXVIIIe colloque de l'AFEAF, Toulouse. Bordeaux : Aquitania, pp. 20-23.