

A thousand years of iron metallurgy on the Dogon plateau (Mali)

Robion-Brunner, Caroline¹, Sébastien Perret², Vincent Serneels², Adama Dembelé³ and Eric Huysecom¹

¹ Dept of Anthropology, University of Geneva, Switzerland; ² Dept of Geosciences, University Fribourg, Switzerland; ³ Mission Culturelle de Bandiagara, Mali
[jmcb@club-internet.fr]

This study is part of the international and interdisciplinary research project «Human population and paleoenvironment in West Africa» (Huysecom 2002). In this framework, the iron production and its development are being studied on the Dogon plateau (Robion-Brunner & Huysecom in press). The generalization of the use of iron had an important impact on the organization of the societies and the management of land usage. The Dogon area has an outstanding archaeological heritage of iron metallurgy as to its importance and variety.

To understand this complex situation on a regional scale and in its diachronic dimension, a multidisciplinary approach was adopted (Serneels 2005). It is based on:

- extensive archaeological surveys (fig. 1) (description of freestanding furnaces and spatial organization; characterization of the metallurgical waste assemblage);
- ethnohistorical interviews (localisation of smith patronymics; reconstruction of the craftsmen's migration patterns and their population history; definition of the role, status and identity of the people involved in the different steps of iron production line);
- in-depth investigations on selected sites including excavations and dating (fig. 2) (reconstruction of the furnaces and the workspace organization);
- archaeometric analyses (fig. 3) (characterization of the metallurgical remains, reconstruction of the smelting processes);
- slag quantification (fig. 4) (estimation of the iron production).

The surveyed area covers mainly the plateau of Bandiagara (approximately 15 000 km²). At present, about twenty ore extraction sites and about fifty smelting sites have been located. The iron production ceased in the 20th century with the arrival of the colonists and the introduction of scrap iron. We know it must have been significant in the 19th century. But radiocarbon dating shows that iron metallurgy in this area started not later than the 6th century AD.

Based on the investigation of the slags and the excavation of several furnaces, at least six technological groups could be differentiated and mapped (Fig. 5.). They are distinguished by the size of the slag dumps, the organization of the workspace, the particular furnace designs and the metallurgical waste assemblage.

The *Fiko group* forms a very important production district with mostly large-scale iron smelting sites, as shown by huge slag dumps. The slag dumps are crater shaped and of irregular morphology. Very large furnaces (combustion chambers up to 2.50x1.75m) are located in the crater centres, kept clear by retaining slag walls. The furnaces consist of a bathtub-shaped pit with clay lining, and a superstructure made of slags and clay. They worked by natural draft with several dozen tuyères. This technology is dominated by tapped slag, associated to slow cooling furnace slags and platter-shaped silica-rich slags formed at the mouth of the tuyères.

The *Ouin group* yielded several small crater-shaped slag dumps, each with a single furnace in its centre. The furnaces operated by natural draft are circular with a small pit and a shaft made of clay bricks and pieces of slag. Stairs made of large stones gave access to the chimney mouth. Most of the slag is tapped. The waste assemblage is relatively similar to the *Fiko group*, but the slags are generally

smaller.

The amount of waste and the workspace organization of the *Ama group* smelting sites are close to those of the *Ouin group*. The furnaces are quite small and probably worked by natural draft with 5 apertures for the tuyères. Most of tuyères are blocked by slag, suggesting a deliberate obstruction at the end of the smelting process. The slag is generally tapped and shows a characteristic of curved plates due to a large gas bubble in the centre.

The sites of the *Aridinyi group* (Huysecom 2001) show medium to large scale, irregular slag heaps with retaining walls made of slags. The furnaces are massive constructions with thick walls and a circular pit. They have 6 apertures including a larger one acting as a door for the removal of the iron and waste products after the smelt. A characteristic large slag block of up to 80 kg forms in the furnace pit and is associated to platter-shaped silica-rich slags.

The *Ennde group* is characterized by a sporadic iron production as illustrated by very small isolated waste dumps associated to single furnaces. The circular furnaces are relatively small and half-buried, and worked by natural draft. There are generally five apertures for the tuyères. In front of the furnaces, a pit gave access to the front door. All of the slags were formed inside the furnace, and it is possible to distinguish dense fayalitic slags with a vertical flow structure, and silica-rich irregular slags.

To finish this overview, the large scale smelting sites of the *Tintam group* consist of huge slag dumps similar to those of the *Fiko group*. The thick walls of the very large furnaces are made of stones, slags and clay. The internal layer of the chimney is covered with tuyère fragments. The waste assemblage is largely dominated by corded tapped slag, associated to platter-shaped silica-rich slag.

Most of these distinct technologies coexisted in a small area up to the 20th century, suggesting that smelting technologies may be tributary to cultural factors as much as to functional considerations such as yield or charcoal consumption. The different groups also give evidence of specific economic configurations. Many of them just supplied the local market in iron for the daily use. Others, such as the *Fiko group* for example, have been calculated to have produced iron in the order of tens of thousands of tons over more than a thousand years, obviously without major technological change. It is quite puzzling to note that, while the many small-scale smelting sites on the eastern border of the Dogon plateau continued to fulfil the local needs, just some 50 km westwards a group of highly productive sites was supplying a vast basin with huge quantities of iron made with an efficient technology. It seems that for centuries, this iron never supplanted the small-scale iron productions, strongly impermeable to technological change.

Future work will emphasize these questions by further excavations and dating of smelting sites, and by the systematic quantification of the iron production of each technological group. Such, we will obtain an accurate vision of the development and the evolution of these technologies and their markets.

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Figures:

Fig.1. A large-scale iron smelting site in the vicinity of the village of Tintam.

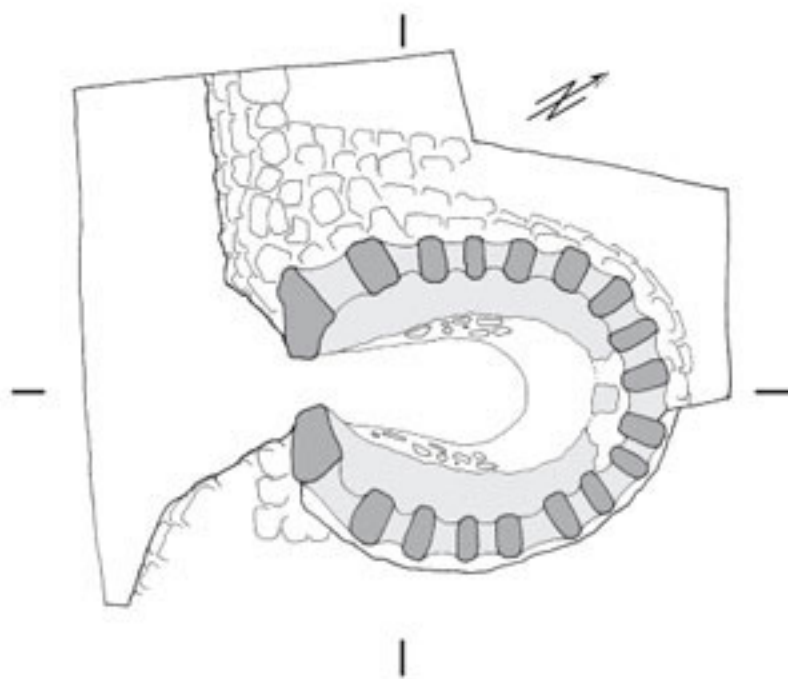
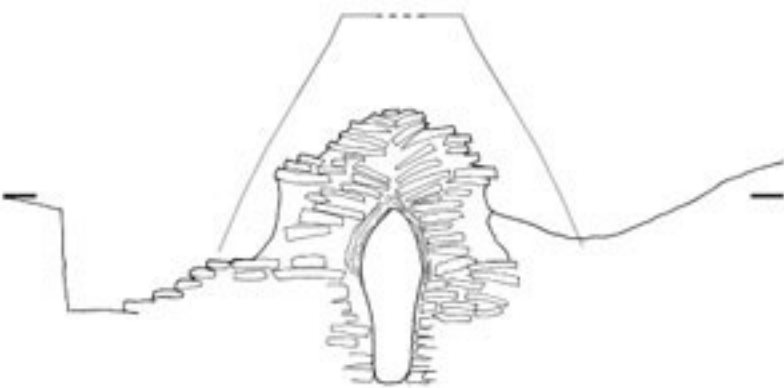
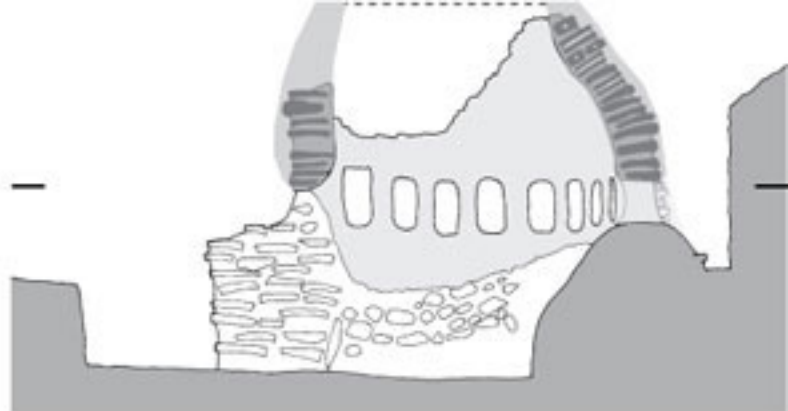
Fig. 2. Reconstitution of the Kema furnaces.

Fig. 3. Siliceous slag cakes with fused tuyères; thin section and EDS images.

Fig. 4. Slag heap quantification: 3D reconstitution of the upper surface and a sample profile (example from the Fiko smelting site).

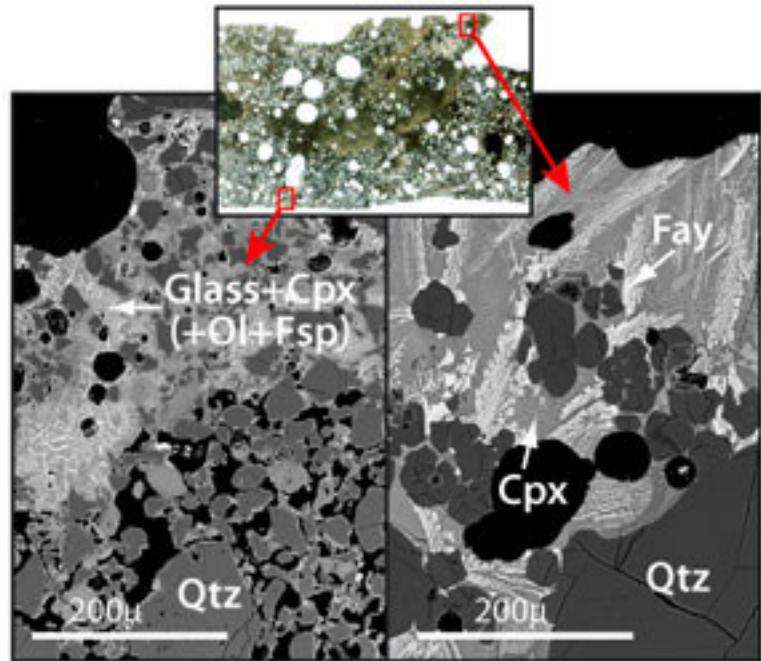
Fig. 5. Mapping of the smelting sites of six identified technological groups.

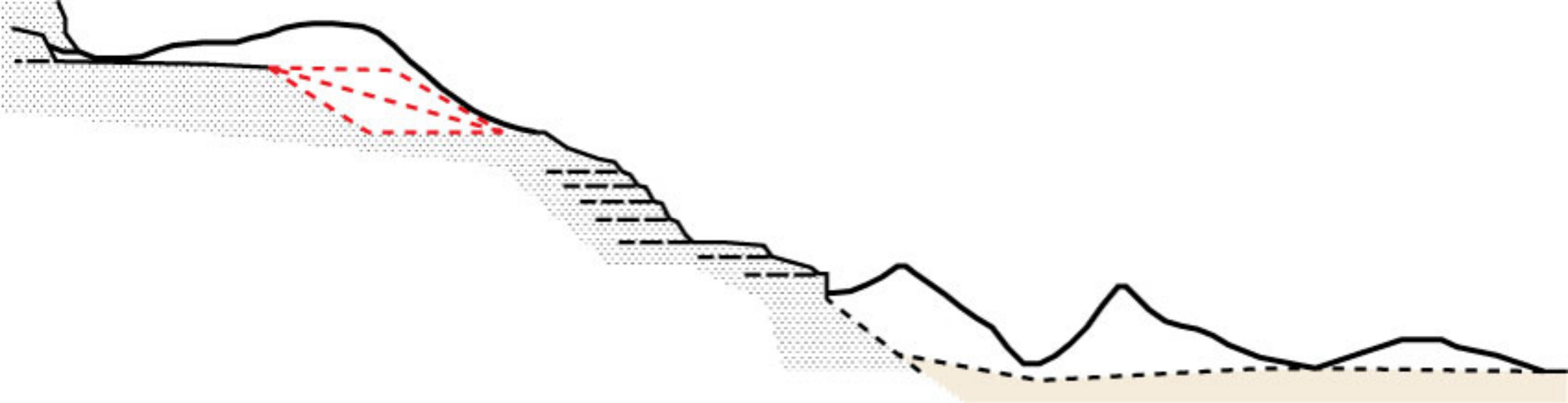


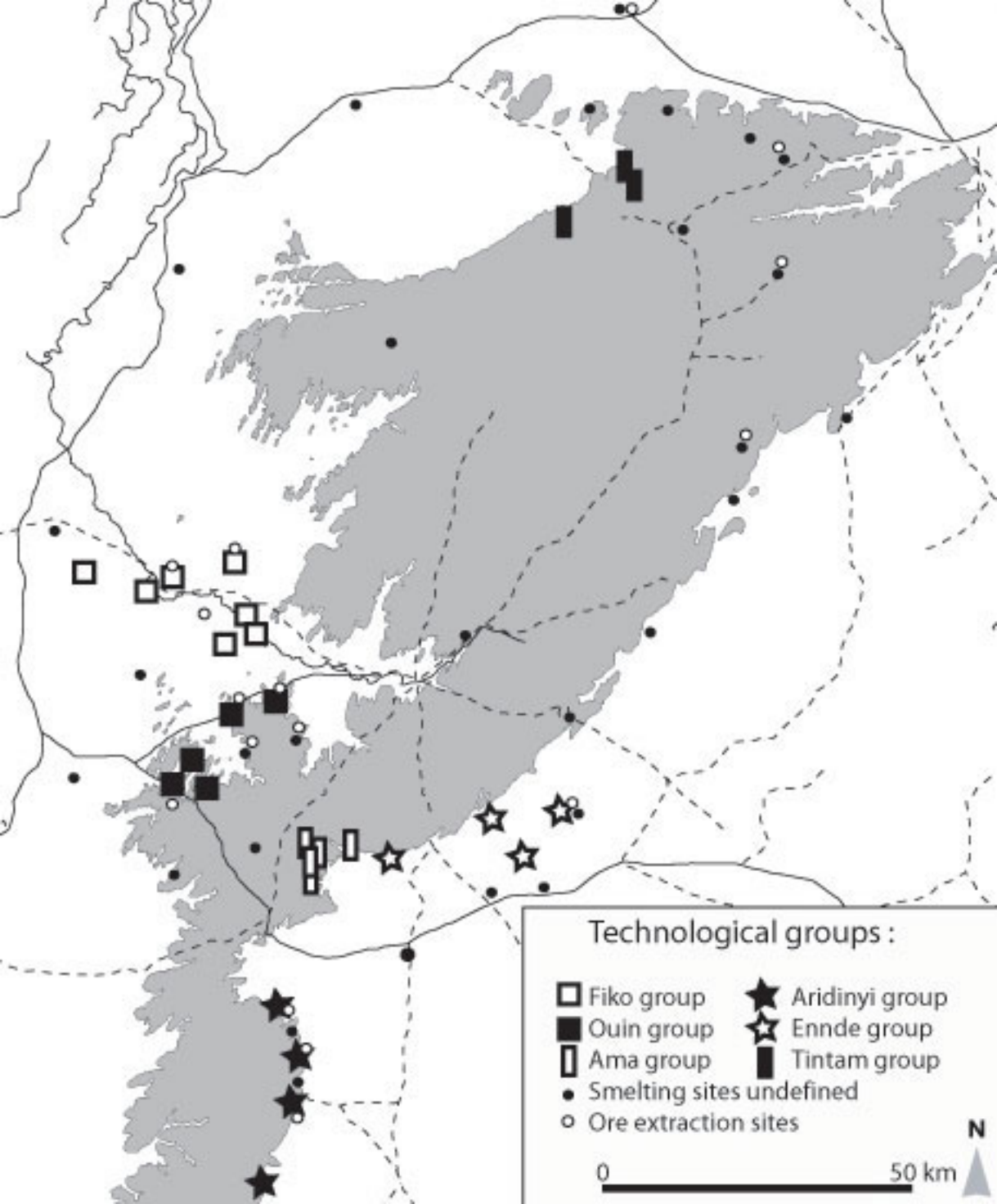


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Technological groups :

- Fiko group
- Quin group
- ▭ Ama group
- ★ Aridinyi group
- ☆ Ennde group
- ▬ Tintam group
- Smelting sites undefined
- Ore extraction sites

