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Evolution & Behaviour

# 7000 years of the peopling of present-day France revealed by paleogenomics

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*A large genomic study reveals ancient demographic events that accompanied the transition to agriculture and changes in metallurgic practices in France by analyzing 243 individuals from archaeological sites representing a 7,000-year time span, from the Mesolithic period (before the onset of agriculture) to the Iron*

*Image credits: Antea-Archéologie*

By accessing the genomes of past populations, researchers have revealed how migrations have been at the origin of major cultural changes for our societies. Some of them have shaped Europe's modern genetic heritage. In France, this type of study had only been carried out on a limited number of archaeological sites or on a few genetic markers. Fruit of the collaboration between palaeogeneticists and archaeologists, we have studied the genomic data of 243 individuals sampled in 54 French archaeological sites to trace 7,000 years of history, from the Mesolithic to the Iron Age.

With more than a million years of human occupation, the territory corresponding to France today has a long, rich, and complex history. Indeed, its history did not begin with the Gauls, with all due respect to Asterix and Obelix. More likely, populations that colonized its territory since 6000 years BC mainly shaped France's present-day society. A large amount of archaeological data were collected during the last century and still, we know very little about the impact that each migrating population has had on modern populations. It is a long-standing debate as to whether sudden changes in material culture apparent in the archaeological record can be attributed to the spread of culture or to population movements.

A first attempt to address this question was to look at the gene pool of modern populations. Indeed, over time, demographic processes have left distinct signatures in the genomes of modern populations. Even if we now have access to the whole genomes of thousands of humans, using them to infer each ancestral population's impact is particularly difficult

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due to the complexity of population dynamics. Ancient DNA (aDNA) research allows us to look directly at the DNA from the period of interest and give insights into the evolution of ancient populations' gene pool composition. But it's only recently that large-scale ancient genomic studies have become common thanks to technical improvement.

To shed light on French populations' history, we extracted DNA from 243 individuals from archaeological sites representing a 7,000-year time span, from the Mesolithic period (before the onset of agriculture) to the Iron Age. We focused on different genetic markers, uniparentally inherited markers: mitochondrial genome and the Y chromosome, and on a set of 120 nuclear markers associated with polymorphisms linked to known physiological traits (pigmentation, innate immunity, etc.). In addition, we analyzed a partially overlapping dataset of 58 low-coverage ancient genomes.

From these genetic data, it appears that after the last ice age, two great periods of migration enriched and partially replaced the European Paleolithic-Genetic background. Some 18,000 years before our era, once the glacier retreated, hunter-gatherers who had taken refuge in southwestern Europe gradually re-conquered the north. Around 6000 years BCE, the arrival of the first peasants is perceptible by an increase in genetic diversity. Their proximity with the Anatolian populations confirms their Southeastern Middle East origin, predicted by archaeology.

But hunter-gatherers do not totally disappear as we observe during the Middle Neolithic, the reappearance of their genetic heritage, which is a sign of an admixture between these populations. Where, when, and how often this admixture happens is still in debate.

At the onset of the Bronze Age (3500 to 2100 BCE), we observed a substantial gene flow from individuals deriving part of their ancestry from Pontic Steppe herders.

The study of genomes dating from the early Bronze Age (2100 to 860 BCE) confirms that the influence of these populations, who came from the northern Black Sea and are believed to have introduced Indo-European languages into Europe, continued and then intensified in what is now French territory. By contrast, there was no major gene flow from outside populations during the transition from the Bronze Age to the Iron Age, suggesting that cultural changes primarily drove this transition.

If our way of life has indeed changed during these seven millennia, some genetic markers related to the immune system or pigmentation were already present in Neolithic populations at frequencies similar to those observed in current European populations. However, none of the genotyped individuals carried the mutation responsible for the adulthood persistence of lactase – an enzyme that breaks down the milk sugar lactose.

By portraying the past diversity of culture and origins of the French and European communities, we have shown how migration and admixture play a key role in our society's cultural and technological "evolution". One could say that the last century of immigration is nothing less than the continuation of European History since prehistoric times.