

# The Mesolithic genetic legacy in the first Neolithic societies sheds light on the processes of admixture in Europe

Maité Rivollat<sup>\*1,2</sup>, Choongwon Jeong<sup>3</sup>, Stephan Schiffels<sup>2</sup>, Isil Kucukkalipci<sup>2</sup>, Marie-Hélène Pemonge<sup>4</sup>, Adam Ben Rohrlach<sup>2</sup>, Kurt Alt<sup>5,6</sup>, Didier Binder<sup>7</sup>, Susanne Friederich<sup>8</sup>, Emmanuel Ghesquière<sup>9</sup>, Detlef Gronenborn<sup>10</sup>, Luc Laporte<sup>11,12</sup>, Philippe Lefranc<sup>13,14</sup>, Harald Meller<sup>8</sup>, Hélène Réveillas<sup>4</sup>, Eva Rosenstock<sup>15</sup>, Stéphane Rottier<sup>16</sup>, Chris Scarre<sup>17</sup>, Ludovic Soler<sup>18</sup>, Joachim Wahl<sup>19</sup>, Johannes Krause<sup>20</sup>, Marie-France Deguilloux<sup>21</sup>, and Wolfgang Haak<sup>2</sup>

<sup>1</sup>De la Préhistoire à l'Actuel : Culture, Environnement et Anthropologie (PACEA) – Université Sciences et Technologies - Bordeaux I, CNRS : UMR5199, Ministère de la Culture et de la Communication – Bâtiment B8 Université de Bordeaux allée Geoffroy St Hilaire 33615 PESSAC CEDEX, France

<sup>2</sup>Max Planck Institute for the Science of Human History, Department of Archaeogenetics (MPI-SHH) – Kahlaische Strasse 10, 07745 Jena, Germany

<sup>3</sup>Seoul National University, School of Biological Sciences, Seoul – South Korea

<sup>4</sup>De la Préhistoire à l'Actuel : Culture, Environnement et Anthropologie (PACEA) – Université de Bordeaux, Centre National de la Recherche Scientifique : UMR5199 – Université de Bordeaux Bâtiment B8 - CS50023 Allée Geoffroy Saint Hilaire 33615 PESSAC CEDEX, France

<sup>5</sup>Danube Private University, Krems – Austria

<sup>6</sup>Integrative Prähistorische und Naturwissenschaftliche Archäologie, Basel – Switzerland

<sup>7</sup>Cultures et environnements. Préhistoire, Antiquité, Moyen Age (CEPAM) – Université Côte d'Azur, CNRS : UMR7264 – Nice, France

<sup>8</sup>Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt (LDA-LSA) – Richard-Wagner-Straße 9 06114 Halle (Saale), Germany

<sup>9</sup>Institut National de Recherches Archéologiques Préventives (INRAP) – INRAP – France

<sup>10</sup>Römisch-Germanisches Zentralmuseum (RGZM) – Germany

<sup>11</sup>Centre de Recherche en Archéologie, Archéosciences, Histoire (CReAAH) – Le Mans Université, Université de Nantes, Université de Rennes 1, Ministère de la Culture et de la Communication, Institut national de recherches archéologiques préventives, Université de Rennes 2, Centre National de la Recherche Scientifique : UMR6566, Centre national de la recherche scientifique - CNRS (France) – Université de Rennes 1 Bâtiment 24-25 Campus de Beaulieu 263, Avenue du général Leclerc Campus de Beaulieu CS 74205 -35042 Rennes Cedex- France, France

<sup>12</sup>CNRS – CNRS : UMR6566 – France

<sup>13</sup>Institut National de recherche Archéologiques préventives (INRAP) – Ministère de la Culture et de la Communication – centre archéologique de Strasbourg , 10 rue d'Altkirch, 67000 Strasbourg, France

<sup>14</sup>Archimède (Archimède) – Université de Strasbourg, CNRS, CNRS : UMR7044 – Maison Interuniversitaire des Sciences de l'Homme d'Alsace, 5 allée du Général Rouvillois, CS50008, 67083 Strasbourg cedex, France, France

<sup>15</sup>Freie Universität Berlin, Institut für Prähistorische Archäologie, Berlin – Germany

<sup>16</sup>De la Préhistoire à l'Actuel : Culture, Environnement et Anthropologie (PACEA) – Université de Bordeaux, Centre National de la Recherche Scientifique : UMR5199 – Bâtiment B8 Université de Bordeaux allée Geoffroy St Hilaire 33615 PESSAC CEDEX, France

<sup>17</sup>Department of Archaeology, University of Durham, England – United Kingdom

---

<sup>18</sup>Service d'Archéologie Départementale Charente-Maritime – Département de Charente Maritime – Service d'Archéologie départementale Caserne Brémond d'Ars Petite rue du Séminaire 17100 Saintes, France

<sup>19</sup>State Office for Cultural Heritage Management Baden-Württemberg, Osteology, Konstanz – Germany

<sup>20</sup>Max Planck Institute for the Science of Human History – Germany

<sup>21</sup>De la Préhistoire à l'Actuel : Culture, Environnement et Anthropologie (PACEA) – CNRS : UMR5199, Ministère de la Culture et de la Communication, Université de Bordeaux – Bâtiment B8 Université de Bordeaux allée Geoffroy St Hilaire 33615 PESSAC CEDEX, France

### Abstract

In the past ten years, genomic data were obtained on hunter-gatherers from the Upper Paleolithic to the Mesolithic, from all over Europe. Although scarce and often with a poor DNA preservation, these data have led to a better understanding of the genetic substructure of the Mesolithic groups.

At the beginning of the Holocene, the Neolithic transition from foraging to farming spread as a new lifestyle towards Europe via distinct continental and Mediterranean routes, starting from 12,000 years ago in the Middle East. Both streams eventually overlapped in Western Europe. Here, a complex scenario of contact, interaction and exchange with autochthonous hunter-gatherers resulted in a mosaic pattern of the material culture between the Mesolithic and the Late Neolithic that is well-known in archaeology.

Investigated in greater detail using genomic data, incoming farmer groups have been shown to have a clear Near Eastern/Anatolian cultural and genetic background with only limited genetic contribution from hunter-gatherers for at least two millennia from the south-east to Western Europe, despite evidence of mutual material exchange. However, so far, no genomic data was available from modern-day France, the key region where both routes converged.

Here, in the framework of the collaborative project INTERACT (ANR/DFG), we present new genome-wide data covering today's France and Germany from the Mesolithic to the Neolithic (7000-3000 BCE). Utilising the genetic substructure observed in hunter-gatherer groups across Europe, we are able to trace characteristic patterns of admixture between incoming farmers and indigenous hunter-gatherers in different regions, which are consistent with both routes of the Neolithic expansion. In particular, Western European early farmers show a higher proportion of specific Western Hunter-Gatherer ancestry compared to those linked to South-eastern or Central Europe. The proportion of Hunter-Gatherer component also varies regionally, and the highest values can be found in the French Mediterranean coast (up to 55%). Here, we were able to estimate the initial admixture date to have occurred about four generations back in time, i.e. about a century after the first Neolithic farmers settled on the coast.

Our data shed a new light on the complexity of biological interactions between human groups during the Neolithic expansion and establishment in Western Europe, echoing the archaeological knowledge and confirming major regional variations. This increasing resolution paves the way for a finer, multi-scale approach to better document the processes implied in the mobility and evolution of prehistoric groups.

**Keywords:** Mesolithic, Neolithic transition, ancient DNA, Western Europe, interactions

---

\*Speaker