

# Changing climates, evolving humans

## Environmental Factors in the Chronology of Human Evolution and Dispersal (EFCHED)

The £2 million EFCHED programme brought together archaeologists, palaeoanthropologists, who study the archaeological and anatomical remains of humans and their hominid ancestors, and palaeoecologists, who study the environments in which people lived.

The programme used many new techniques including:

- Combining geography and genetics with computer models of climate and human dispersal to give new insights and improved confidence in interpreting archaeological evidence for the migration of *Homo erectus* out of Africa around 1.8 million years ago, into Asia and later into Europe.
- New methods for extracting tooth enamel proteins, and for analysing the isotopes in single amino acids, which may allow direct measurements of human diets by analysing human teeth and bones at least one million years old. The present method relies on collagen, which doesn't survive much more than 100,000 years.
- Novel methods for measuring the age of individual grains of sand. This has allowed accurate dating of human settlements and artefacts in Africa during the key period when *Homo sapiens* migrated into Asia, and allows the scientists to correlate human activities with climate and sea-level predictions for the same period.

### Climate and civilisation

The world's climate has remained relatively stable since the last ice age ended 12,000 years ago. This stable climate over a long period has aided agricultural development, which began in the fertile crescent between the Tigris and Euphrates rivers in Mesopotamia (Iraq). From agriculture has come civilisation.

### Tectonics – earthquakes and volcanoes

Many of the regions important to early human development, such as the African Rift Valley, much of the Middle East, southern Europe and south-east Asia are tectonically volatile – large earthquakes and volcanoes constantly alter the landscape. We usually think of these processes as dangerous and destructive, threatening life. But they also create landscapes that are attractive to human settlement: fertile volcanic soils, localised basins that trap sediments and freshwater supplies, ecological diversity, and complex landscapes with natural barriers and enclosures that enable humans, with few technological aids, to hide and to successfully hunt down otherwise elusive and fast-moving animal prey.

EFCHED has contributed to international research on human evolution. Many of the EFCHED projects have received additional funding from other organisations or have been part of larger studies.

### NERC research facilities

NERC's Life Science Mass Spectrometry Facilities –  
Bristol, East Kilbride, Lancaster  
Tel: 01355 270138

NERC Oxford University Radiocarbon Accelerator Dating Service  
Tel: 01865 285229

### More information

**Steering Committee Chair**  
Professor Clive Gamble  
Email: Clive.gamble@rhul.ac.uk  
Tel: 01784 414673

**Programme administrator**  
Dr Sally Palmer  
Email: s.palmer@nerc.ac.uk  
Tel: 01793 411701



The Natural Environment Research Council funds world-class science in universities and our own research centres that increases knowledge and understanding of the natural world. We are tackling the 21st century's major environmental issues such as climate change, biodiversity and natural hazards.

For further information about NERC contact: NERC Communications, Polaris House, North Star Avenue, Swindon SN2 1EU, tel: 01793 411500, fax: 01793 411510, email: requests@nerc.ac.uk, www.nerc.ac.uk



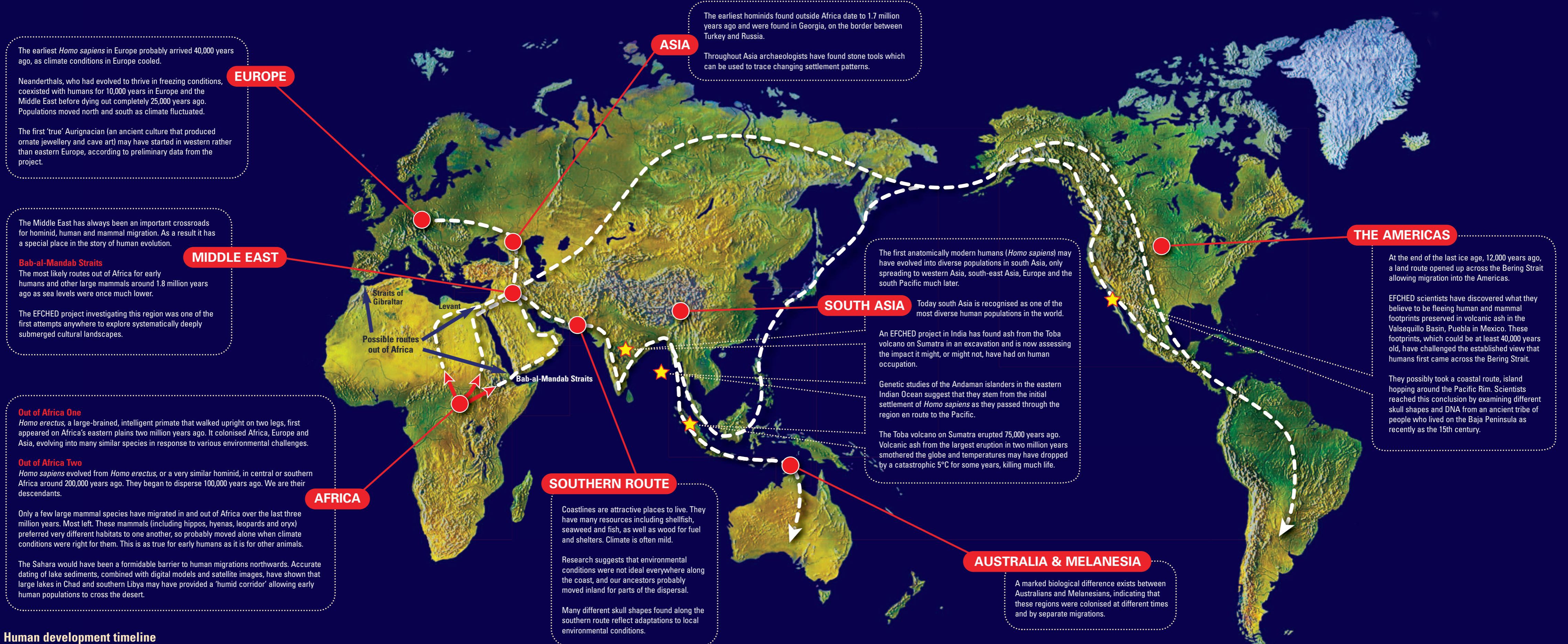
# Changing climates, evolving humans

## Scientific certainties and uncertainties

Humans are a truly global species. We have colonised every continent. We have adapted and thrived in the harshest of environments. How did this happen? And what part did the environment, including climate change, play in human evolution and development?

Between 2002 and 2006 the Natural Environment Research Council funded an ambitious programme, Environmental Factors in the Chronology of Human Evolution and Dispersal (EFCHED), to investigate humanity's rapid expansion out of Africa and across the globe. The programme sought answers to several questions. When did humans move out of Africa? Did humans leave alone or did their dispersal coincide with widespread mammal migrations? Was there just one major movement of people or were there many?





### Human development timeline

Pliocene 5 – 1.8 million years ago			Pleistocene 1.8 million – 11,000 years ago			Holocene 11,000 years ago – today		
Earth's climate begins to cool								
5 million	3 million	2.6 million	1.8 million	1.5-1 million	500,000	250,000	200,000	100,000
A split occurs between chimpanzees (our closest living relative) and our ancestors.	Some ice sheets form on northern continents. Sea levels fall by up to 40 metres.	The oldest stone tools – simple struck flakes and cores – are used in Europe.	<i>Homo erectus</i> found on plains of East Africa.	Well-worked stone bifaces (hand axes) appear. These Acheulean tools are found all over the Old World.	Steady seasonal rain in the Sahara. <i>Homo erectus</i> controls fire.	Neanderthals evolve from <i>Homo erectus</i> in Europe and south-west Asia.	<i>Homo sapiens</i> evolve from <i>Homo erectus</i> in Africa south of the Sahara.	<i>Homo sapiens</i> move out of Africa to the Middle East and Asia.
80,000	40,000	25,000	18,000	12,000	8,200			
Start of the last ice age.	A major Atlantic Ocean circulation slowed and stopped, temperatures in Europe plummeted. Humans found in Europe, south-east Asia and Australia. On the island of Flores in Indonesia they would have encountered a one-metre tall hominid <i>Homo floresiensis</i> , a distant descendant of a much earlier migration, possibly as old as Out of Africa One. Possibly our ancestors arrived in the Americas.	Neanderthals disappear in Europe.	Ice age reaches a peak. 30m drop in sea level. Extensive tropical deserts.	The ice age ends possibly opening up land routes across the Bering Strait between northern Russia and North America. Sea levels similar to present levels. First agriculture develops, soon followed by the earliest civilisations.	Dramatic and abrupt, but temporary cooling caused by a slowdown of a major Atlantic Ocean circulation.			

**EUROPE**

The earliest *Homo sapiens* in Europe probably arrived 40,000 years ago, as climate conditions in Europe cooled.

Neanderthals, who had evolved to thrive in freezing conditions, coexisted with humans for 10,000 years in Europe and the Middle East before dying out completely 25,000 years ago. Populations moved north and south as climate fluctuated.

The first 'true' Aurignacian (an ancient culture that produced ornate jewellery and cave art) may have started in western rather than eastern Europe, according to preliminary data from the project.

**MIDDLE EAST**

The Middle East has always been an important crossroads for hominid, human and mammal migration. As a result it has a special place in the story of human evolution.

**Bab-al-Mandab Straits**  
The most likely routes out of Africa for early humans and other large mammals around 1.8 million years ago as sea levels were once much lower.

The EFCHED project investigating this region was one of the first attempts anywhere to explore systematically deeply submerged cultural landscapes.

**AFRICA**

**Out of Africa One**  
*Homo erectus*, a large-brained, intelligent primate that walked upright on two legs, first appeared on Africa's eastern plains two million years ago. It colonised Africa, Europe and Asia, evolving into many similar species in response to various environmental challenges.

**Out of Africa Two**  
*Homo sapiens* evolved from *Homo erectus*, or a very similar hominid, in central or southern Africa around 200,000 years ago. They began to disperse 100,000 years ago. We are their descendants.

Only a few large mammal species have migrated in and out of Africa over the last three million years. Most left. These mammals (including hippos, hyenas, leopards and oryx) preferred very different habitats to one another, so probably moved alone when climate conditions were right for them. This is as true for early humans as it is for other animals.

The Sahara would have been a formidable barrier to human migrations northwards. Accurate dating of lake sediments, combined with digital models and satellite images, have shown that large lakes in Chad and southern Libya may have provided a 'humid corridor' allowing early human populations to cross the desert.

**ASIA**

The earliest hominids found outside Africa date to 1.7 million years ago and were found in Georgia, on the border between Turkey and Russia.

Throughout Asia archaeologists have found stone tools which can be used to trace changing settlement patterns.

**SOUTH ASIA**

The first anatomically modern humans (*Homo sapiens*) may have evolved into diverse populations in south Asia, only spreading to western Asia, south-east Asia, Europe and the south Pacific much later.

Today south Asia is recognised as one of the most diverse human populations in the world.

An EFCHED project in India has found ash from the Toba volcano on Sumatra in an excavation and is now assessing the impact it might, or might not, have had on human occupation.

Genetic studies of the Andaman islanders in the eastern Indian Ocean suggest that they stem from the initial settlement of *Homo sapiens* as they passed through the region en route to the Pacific.

The Toba volcano on Sumatra erupted 75,000 years ago. Volcanic ash from the largest eruption in two million years smothered the globe and temperatures may have dropped by a catastrophic 5°C for some years, killing much life.

**SOUTHERN ROUTE**

Coastlines are attractive places to live. They have many resources including shellfish, seaweed and fish, as well as wood for fuel and shelters. Climate is often mild.

Research suggests that environmental conditions were not ideal everywhere along the coast, and our ancestors probably moved inland for parts of the dispersal.

Many different skull shapes found along the southern route reflect adaptations to local environmental conditions.

**AUSTRALIA & MELANESIA**

A marked biological difference exists between Australians and Melanesians, indicating that these regions were colonised at different times and by separate migrations.

**THE AMERICAS**

At the end of the last ice age, 12,000 years ago, a land route opened up across the Bering Strait allowing migration into the Americas.

EFCHED scientists have discovered what they believe to be fleeing human and mammal footprints preserved in volcanic ash in the Valsequillo Basin, Puebla in Mexico. These footprints, which could be at least 40,000 years old, have challenged the established view that humans first came across the Bering Strait.

They possibly took a coastal route, island hopping around the Pacific Rim. Scientists reached this conclusion by examining different skull shapes and DNA from an ancient tribe of people who lived on the Baja Peninsula as recently as the 15th century.