**Impact of climate change on the transition of Neanderthals to modern humans in Europe**

The Neanderthals, the human species which is closest to ours, lived in Eurasia for some 350,000 years. Some of the Neanderthals' defining characteristics were shorter, stockier bodies as well as brains which were as large as ours, and often larger. They had a sophisticated culture, controlled fire, made clothing, were skilled hunters, and genetic evidence indicates some degree of interbreeding with modern humans. However, during the last Ice Age and shortly after the arrival of anatomically modern humans in Europe, the Neanderthals became extinct about 40,000 years ago. What could have caused their demise? Were they pushed "over the edge" by the arrival of modern humans, or were there some other factors involved? A new study published in the journal Proceedings of the National Academy of Sciences suggests that climate change may have had an important role in the Neanderthal extinction.

The climate of the last Ice Age was one of extreme and rapid changes, with temperature shifts in some parts around the North Atlantic of 10 degrees Celsius or more occurring in just a few decades. The chemical makeup of stalagmites in caves changes as a result of these shifts in climate and as they grow in thin layers every year, they often preserve an archive of climate change over many thousands of years. Using stalagmites from two caves in Romania, the new study provides a more detailed record of climate change in continental Europe than was previously available, showing that the region experienced a series of prolonged cold and arid conditions between 44,000 and 40,000 years ago. Each of these cold spells corroborate well an almost total absence of archaeological artifacts left by the Neanderthals throughout Europe. Neanderthalian population apparently decreased and was then not able to recover in the regions already occupied by modern humans.

This fact suggests that the rapid environmental change and ecologic stresses triggered by these millennial-scale hostile climate intervals may have been the pacesetter of multiple depopulation-repopulation cycles. Ultimately, modern humans had a more sophisticated subsistence strategy better adapted to life in the arid cold steppe expanding across Europe. Nevertheless, for several millennia to come, recurring cold intervals continued to cause even modern human populations to suffer which ultimately drawn the demographic map of Europe's Middle–Upper Paleolithic transition.

**Abstract (from the article):** T*wo speleothem stable isotope records from East-Central Europe demonstrate that Greenland Stadial 12 (GS12) and GS10—at 44.3– 43.3 and 40.8–40.2 ka—were prominent intervals of cold and arid conditions. GS12, GS11, and GS10 are coeval with a regional pattern of culturally (near-)sterile layers within Europe's diachronous archeologic transition from Neanderthals to modern human Aurignacian. Sterile layers coeval with GS12 precede the Aurignacian throughout the middle and upper Danube region. In some records from the northern Iberian Peninsula, such layers are coeval with GS11 and separate the Châtelperronian from the Aurignacian. Sterile layers preceding the Aurignacian in the remaining Châtelperronian domain are coeval with GS10 and the previously reported 40.0- to 40.8-ka cal BP time range of Neanderthals' disappearance from most of Europe. This suggests that ecologic stress during stadial expansion of steppe landscape caused a diachronous pattern of*

*depopulation of Neanderthals, which facilitated repopulation by modern humans who appear to have been better adapted to this environment. Consecutive depopulation–repopulation cycles during severe stadials of the middle pleniglacial may principally explain the repeated replacement of Europe's population and its genetic composition.*