# Human Evolution at the Crossroads

## Reporting

Project Information

**CROSSROADS**

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EBERHARD KARLS UNIVERSITAET TUEBINGEN
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# Periodic Reporting for period 4 - CROSSROADS (Human Evolution at the Crossroads)

**Reporting period:** 2021-10-01 to 2022-03-31

## Summary of the context and overall objectives of the project

Among the most important research questions in European paleoanthropology are the timing, number and origin of early human dispersals into (and out of) the continent; the identity and number of hominin species; and their possible interactions, including cultural or biological exchanges. These questions remain open in large part because of the scarcity of paleoanthropological research in South-East

Europe, a region located at the crossroads between continents, and therefore a long hypothesized dispersal route. The region is thought to have also acted as a glacial refugium for fauna, flora and possibly human populations, and may have fostered late survival of archaic hominin species and therefore increased likelihood of interactions with newly arrived populations and/or species. New evidence from this region can therefore contribute substantially to our knowledge about human evolution and modern human origins, and ultimately help answer some of the fundamental questions of humanity: 'where did we come from and how did we get here?'

CROSSROADS was an ambitious, groundbreaking research program that built on the foundation of the PI's previous research to further promote paleoanthropological research in Greece and neighboring countries. It focused on the early part of the Paleolithic and had four broadly defined goals: 1. the development of an overarching chronological framework for paleolithic and paleoanthropological evidence in Greece; 2. the development of a paleoenvironmental framework for the Pleistocene of Greece, within which changes in the fossil and archaeological record can be interpreted; 3. the identification of new evidence; and 4. the (re-) interpretation of existing fossil human remains using state of the art approaches.

CROSSROADS was conducted in close collaboration with partners in Greece, including the Ephoreia of Paleoanthropology and Speleology, Greek Ministry of Culture, the National and Kapodistrian University of Athens, the Aristotle University of Thessaloniki, and the American School of Classical Studies at Athens, and internationally.

## Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

The CROSSROADS team collected samples for dating from several paleolithic / paleoanthropological / paleontological sites from diverse regions in Greece. Several scientific articles on this topic were published in international peer reviewed publications, while others are pending. We also collected samples for multi-proxy paleoenvironmental reconstruction, with some results already published, but much more still currently being prepared for publication. A new survey in the Megalopolis basin, MEGAPAL, conducted by the Ephoreia of Paleoanthropology and Speleology and the American School of Classical Studies at Athens, under the direction of E. Panagopoulou, P. Karkanas and PI K. Harvati, was also undertaken to locate new sites and investigate the geological and paleoenvironmetal evolution of the basin during the Middle Pleistocene; as was a new survey in the Mygdonia basin, conducted by the Aristotle University of Thessaloniki and directed by K. Kotsakis, with the collaboration of PI K. Harvati and the CROSSROADS team. Both of these surveys have produced important new results which are being prepared for publication.
Finally, we have made significant progress with the state of the art analysis of the existing human fossil record of the region, which constituted the fourth main goal of the project. Most notable here was the virtual reconstruction and analysis of the Apidima fossil crania, published in July 2019 by PI K. Harvati, CROSSROADS team members and collaborators in the highest ranking scientific journal Nature, and widely reported in the international media. Furthermore, we have developed new techniques and approaches for the interpretation of the fossil human remains, which will be applied to

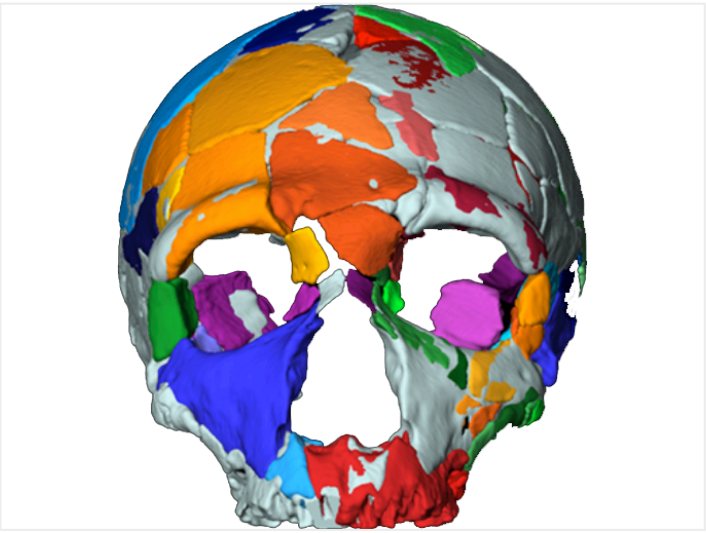
the Greek fossil record in the next phase.

The results of the project's work were presented regularly in scientific conferences and in invited lectures by the PI and team members around the world and virtually. They have also been in many cases extensively reported on in the press, both in Germany (host country of the project) and Greece (where most of the research took place), but also internationally.

## Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

The progress made by CROSSROADS has followed or exceeded expectations.We applied cutting edge virtual anthropology and 3-d geometric morphometric methods to virtually reconstruct and analyze the two human fossil crania from Apidima, Southern Greece, and to date them directly. This study was led by PI K. Harvati in collaboration with the Museum of Anthropology, Medical School of the National and Kapodistrian University of Athens and other CROSSROADS team members and international partners. Results showed that Apidima 2 was a Neanderthal dating to ca. 170 thousand years ago, as expected. However, Apidima 1 was an early modern human, dating to ca. 210 thousand years ago, making it the earliest H. sapiens currently known in Eurasia. This result was completely unexpected, and, for the first time showed that early H. sapiens dispersed earlier than previously thought, reaching much further geographically than previously suspected.

Furthermore, results from the chronological and paleoenvironmental analyses from the Megalopolis basin have demostrated convincingly the role that this region played as a glacial refugium, where human, plant and animal populations survived during glacial times, when large parts of the European continent became uninhabitable. A first study showing this has already been published, while several more supporting this result were presented at the CROSSROADS closing conference and in the pipeline for publication. This is a major result which convincingly demonstrates the presence of humans in the Megalopolis basin at Marathousa 1 during the glacial MIS 12, as confirmed by chronological analyses but also environmental and temperature reconstructions that indicate glacial conditions at the time of human presence..



Virtual Reconstruction of the Apidima 2 Neanderthal cranium (Harvati et al. 2019). Copyright Harvati

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