

UC San Diego

# UC San Diego News Center

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## The Data that Keep on Giving

### A 2016 Excavation in Greece Helps Provide Sweeping New Insights into the Evolution of Indo-European Languages

La Jolla, CA – Genetic data collected during an excavation of a Mycenaean tomb at Kastrouli near Delphi, Greece, have helped an interdisciplinary team including UC San Diego scientists unveil some of the mysteries of ancient patterns of human migration, culture and the evolution of Indo-European languages across eastern Europe and into West Asia 7,000 to 5,000 years ago.

The data, from a 2016 excavation co-led by Thomas Levy, director of the Center for Cyber-Archaeology and Sustainability at UC San Diego's [Qualcomm Institute](#) and School of Social Sciences, and Ioannis Liritzis, then at the University of the Aegean, contributed to the conclusions of a series of three papers published as the cover story of the August 26, 2022, issue of the journal [Science](#).

“This trio of papers changes our understanding of how the Southern Arc’s cultures and languages came to be,” said Levy. “The scope of the datasets brought together here is unprecedented. Data on that scale can answer questions that researchers working in isolation cannot. The findings are the result of a true transdisciplinary collaboration.”

#### Surprises in ancient history

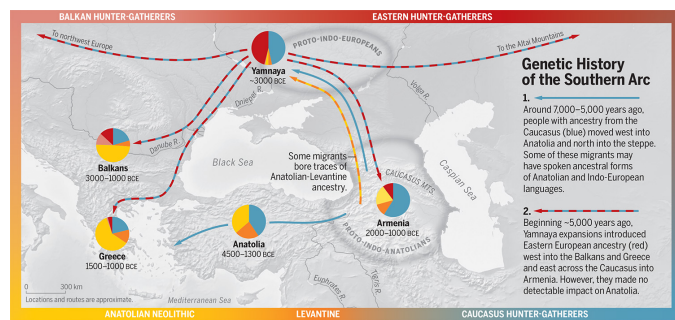
The collaborative effort reached across fields, institutions, and international borders. Led by Ron Pinhasi at the University of Vienna, Songül Alpaslan-Roodenberg at the University of Vienna and Harvard University, and Iosif Lazaridis and David Reich at Harvard University, and involving 202 co-authors, the studies drew on published archaeogenetic records and new DNA analysis of 727 individuals who lived during the Copper and Bronze Ages. These people populated the “Southern Arc,” a swath of land connecting Europe to West Asia through modern Turkey.



*UC San Diego archaeologist Thomas Levy (left) and Henan University distinguished professor Ioannis Liritzis (right) stand in front of a large helium balloon at the Delphi Museum. The team used the balloon to take measurements at the Kastrouli dig site, Greece.*

The findings indicate that, approximately 7,000 to 5,000 years ago, people who spoke a Proto-Indo-Anatolian language migrated from the Caucasus Mountains west into the Anatolian peninsula of modern-day Turkey, and north into the grasslands or “steppe” of modern Russia and Ukraine. The split created the Anatolian and Indo-European branches of this ancestral language.

Those who migrated north into today’s Russia and Ukraine mingled with local populations and gave rise to a culture of steppe herders called the Yamnaya. By about 5,000 years ago, the Yamnaya triggered a series of migrations that saw them traveling west into northwest Europe, east into China and India and south into the Caucasus Mountains and modern Armenia, in a return to the homeland they shared with the people of Anatolia.



*Migration and social integration give rise to new cultures and languages around Eastern Europe and West Asia during the Copper and Bronze Ages.*

This second wave of migrations during the Bronze Age again split the Indo-European branch of the Proto-Indo-Anatolian mother language into its daughter languages, including Greek, Albanian and Armenian.

However, in what was a surprising find for the research team, the results indicate that the Yamnaya did not continue their southward migration into the Anatolian peninsula.

Instead, Anatolia’s peoples remained largely

genetically homogenous and untouched by Yamnaya expansion down to the time of the Roman and Byzantine empires.

“Eastern hunter-gatherer ancestry drops to less than 4% in Mycenaean Greece, where Kastrouli is located,” said Levy. “So our data from Kastrouli helps document the end process of the Yamnaya expansion in the Southern Arc.”

## One step closer to a mystery solved

The results also strongly support a major hypothesis regarding the ancestry of Mycenaean Greeks, the population living on the Greek mainland during the Late Bronze Age.

Further analyzing the genetic data obtained from Kastrouli and other sites, researchers found that Mycenaean Greeks descended from the integration of a Yamnaya-like people into a population similar to the Bronze Age or Early Bronze Age Greeks living on Crete and other islands of the Aegean Sea, at a ratio of about 1:10. The findings contradict an earlier hypothesis, which suggested that the Mycenaean Greeks may have arisen from a mixture of Anatolian and Armenian populations from the east.

The data show that the Yamnaya descendants likely integrated socially into the Aegean population, given the lack of a clear connection between concentration of Yamnaya blood and social status inferred from the circumstances of the individual's burial.

“The new results, supported by our data and earlier records, also show that most of the ancestry of modern Greeks is consistent with deriving from Mycenaeans with a minority contribution from later migrations, which is impressive given that the Aegean has been a crossroads of cultures for thousands of years,” said Liritzis, now a distinguished professor of archaeometry and interdisciplinary approaches to archaeology, cultural heritage and paleoenvironment at the Henan University in China.

The data from Kastrouli mark some of the first collected from central Greece and dating back to the Bronze Age.

## Heritage at risk



*Human bones and the handle and spout of a Mycenaean stirrup jar (to the upper right of the white and black scale) are unearthed from the excavation at Kastrouli.*

Still, questions remain regarding the social structures and ancestry of the people who lived and died at these historical sites. The excavation at Kastrouli focused on two large tombs, including one that yielded numerous well-made Mycenaean stirrup jars, figurines, gold leaf and other artifacts. The tombs' size, construction and burial offerings may offer clues as to their occupants' social status.

However, that well of knowledge has already seen its own share of adversity. Looters targeted the site in the 1990s, dealing damage with tools that included explosives, and the wear and tear of time takes its own toll.

As part of principal investigator Levy's [At-Risk World Heritage and the Digital Humanities project](#) sponsored by the University of California Office of the President's Catalyst program, the 2016 Kastrouli expedition meticulously extracted and recorded data in 3D that has yielded—and continues to yield—findings as part of a larger project documenting at-risk cultural heritage sites across the eastern Mediterranean. The project uses cyber-archaeology, a union of multiple disciplines that include archaeology, computer science, engineering and the natural sciences. This effort enables the creation of 3D digital repositories of excavations, including versions where vegetation has been digitally “stripped away” to reveal archaeological remains, and replicas of ancient sites as they are, providing researchers with a snapshot they can study in perpetuity from anywhere in the world.

For more on the Kastrouli project, visit the website [online](#). To learn more about other cyber-archaeology undertakings, visit the [Center for Cyber-Archaeology and Sustainability's website](#). The full papers, "[The genetic history of the Southern Arc: A bridge between West Asia and Europe](#)," "[Ancient DNA from Mesopotamia suggests distinct pre-pottery and pottery Neolithic migrations into Anatolia](#)," and "[A genetic probe into the ancient and medieval history of Southern Europe and West Asia](#)" can be found online.

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