# Strontium isotope map of Sub-Saharan Africa: A powerful tool for archaeology, forensics and wildlife conservation

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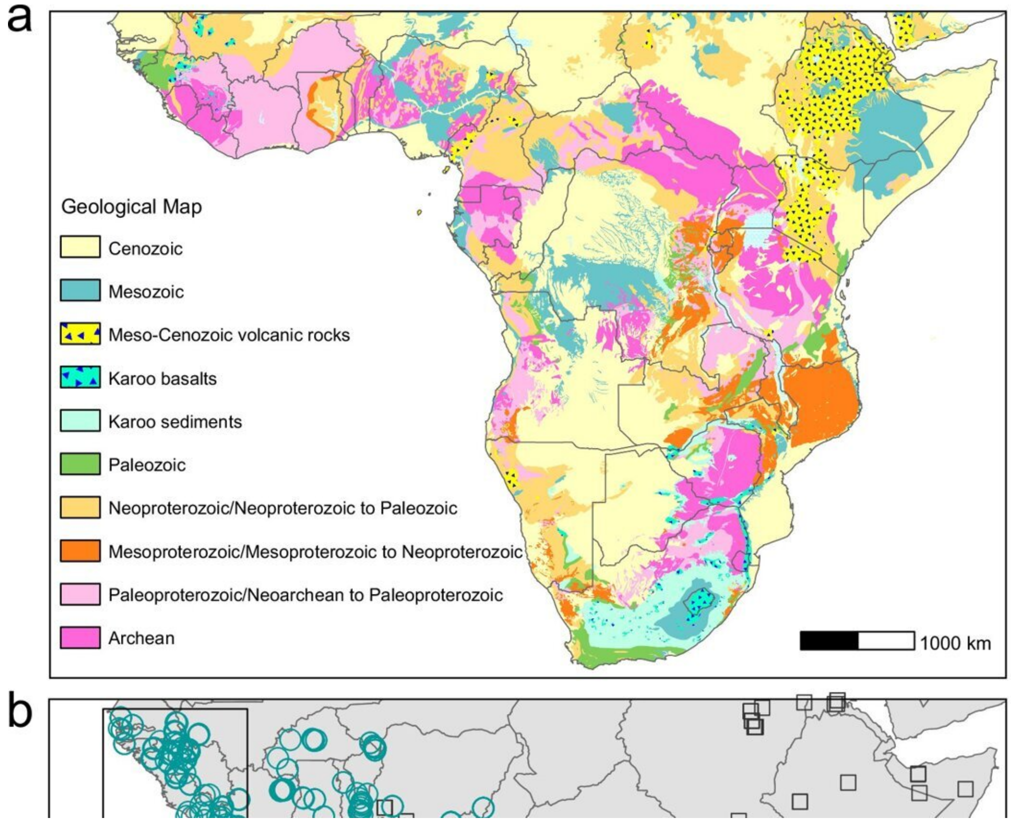


Geological map and sampling locations. Credit: *Nature Communications* (2024). DOI: 10.1038/s41467-024-55256-0

A team of researchers led by UC Santa Cruz recently released a sophisticated new map that reveals, for the first time, the unique "geologic fingerprints" for most of the African continent.

The map will help archaeologists, conservation scientists, and forensics experts match artifacts and plant, animal, and human remains found at locations around the world back to their most likely region of origin within Africa, offering new insights on issues ranging from the history of the transatlantic slave trade to modern wildlife trafficking and human migration patterns.

The research team's methods, and a few demonstrations of the map's capabilities, are published in the journal *Nature Communications*. The map is available for public use through open access. It is the first bioavailable strontium isotope map to show predicted strontium isotope ratios across all of Sub-Saharan Africa.

Strontium is an element present in bedrock and soil that comes in several different chemical forms, called isotopes. The ratio of these isotopes to one another indicates the age and chemical composition of the bedrock in a given region of the planet. Living organisms incorporate strontium from the environment into their tissues in ratios that reflect the local conditions of the place where they developed.

This means researchers can perform isotope analysis on a sample of unknown origin, then use the new isotope map to see which parts of Sub-Saharan Africa are most likely to have produced the specific ratios observed in the sample.

To develop the map, researchers used computer modeling techniques that incorporated 11 predictive variables and strontium isotope data from more than 2,000 samples collected across the African continent. The project took more than a decade to complete and required international coordination among over 100 scientists.

UC Santa Cruz Anthropology Professor Vicky Oelze, who conceptualized the project and is senior author of the new paper, says that strontium isotope mapping of Sub-Saharan Africa has been a significant need for many years.

Isotope analysis can significantly increase understanding of the global movement of people and wildlife, which is especially relevant for a region that was a center of human exploitation and trafficking during the transatlantic slave trade and is now home to numerous endangered and trafficked wildlife species.

But Oelze says the region has long faced "data marginalization," due to a lack of scientific equipment to perform local analysis and an overall lack of samples, resulting from logistical challenges and, in some cases, safety risks from armed conflicts.

"When we started this project, for all of Western Central Africa, there were only two data points, and they were both in Nigeria," she explained.

"Basically, at that time, you couldn't use this type of analysis to investigate any big questions in all of western and western central Africa, because there was no baseline information available. That has long been both an inequity and a missed opportunity, because the geology of western central Africa is so diverse that it makes this a perfect landscape to use this method."

To develop the new map, Oelze and her team combined previously available strontium isotope data for parts of south and east Africa with data from Angola that the core team had published in 2023 and new data from 778 samples collected across 24 countries in western and western central Africa. The team's work provides the first known strontium isotope data for 16 of those countries.

New samples used in the project included wild plants, soils, bones, teeth, and snail shells, which were processed and analyzed primarily at UC Santa Cruz laboratories by postdoctoral fellow Xueye Wang and graduate and undergraduate students.

Samples were provided through a partnership with the Pan African Program, which had been collecting environmental samples for a chimpanzee research project, and a call for samples that went out to the Society of Africanist Archaeologists.

The new data allowed the team to build a powerful predictive model for their map. To explore its historical applications, researchers analyzed the strontium isotope ratios for samples taken from the remains of first-generation enslaved people buried at the Anson Street African Burial Ground in South Carolina and Pretos Novos cemetery in Rio de Janeiro, Brazil.

By combining historical, genetic, and other lines of evidence with the new strontium isotope map, the team was able to predict likely regions of origin for each person with much more specificity than was previously possible.

"One of the main questions that descendants of enslaved people still have today is wanting to know more about where each individual ancestor came from, and our work is helping to provide some of those answers," Oelze said.

"Sub-Saharan Africa is a big place with tremendous cultural diversity, so it's really important to be able to specify whether someone likely came from the Angolan Plateau or the southern coast of Ghana, for example. That tells us something about a person's life history to help us better understand these ancestors and how their legacies contribute to living populations today."

UC Santa Cruz postdoctoral fellow Xueye Wang, who previously studied under Oelze and is lead author of the new paper, said she hopes the team's efforts can help to restore the identities of trafficking victims whom the transatlantic slave trade sought to systematically dehumanize.

"Through this study, we aimed to go beyond academic inquiry, seeking to reclaim the voices of those silenced by history and to provide them with a rightful sense of belonging," she said.

"We hope the results will inspire more researchers to utilize strontium isotopes and other methodologies to contribute to the restoration of the identities, cultures, and lives of individuals and communities whose rights and lives were stripped away during the colonial period."

In addition to shedding new light on history, the map also has important modern applications, like combating wildlife trafficking. Confiscated animal parts from the illegal wildlife trade can be analyzed for their strontium isotope ratios and then be matched against the map, helping conservationists and law enforcement agencies locate potential geographic hubs for the poaching and smuggling networks they're trying to shut down.

Researchers also hope the map could be used for forensic analysis on the remains of the thousands of people who tragically drown in the Mediterranean Sea each year trying to migrate to Europe. If their origins can be traced, then their bodies could potentially be repatriated for proper burial in their home lands.

For each of these applications, Oelze expects that the map will only become more useful with time, as more data becomes available.

"We continue to be very interested in getting more samples from the remaining data-poor regions of the African continent, like the Sahel region, Sudan, and Mozambique," she said.

"We plan to continue our work on filling data gaps, working closely with local archaeologists. In the meantime, we hope this project can make a positive impact."

**More information:** Xueye Wang et al, Strontium isoscape of sub-Saharan Africa allows tracing origins of victims of the transatlantic slave trade, *Nature Communications* (2024). DOI: 10.1038/s41467-024-55256-0

Provided by University of California - Santa Cruz

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