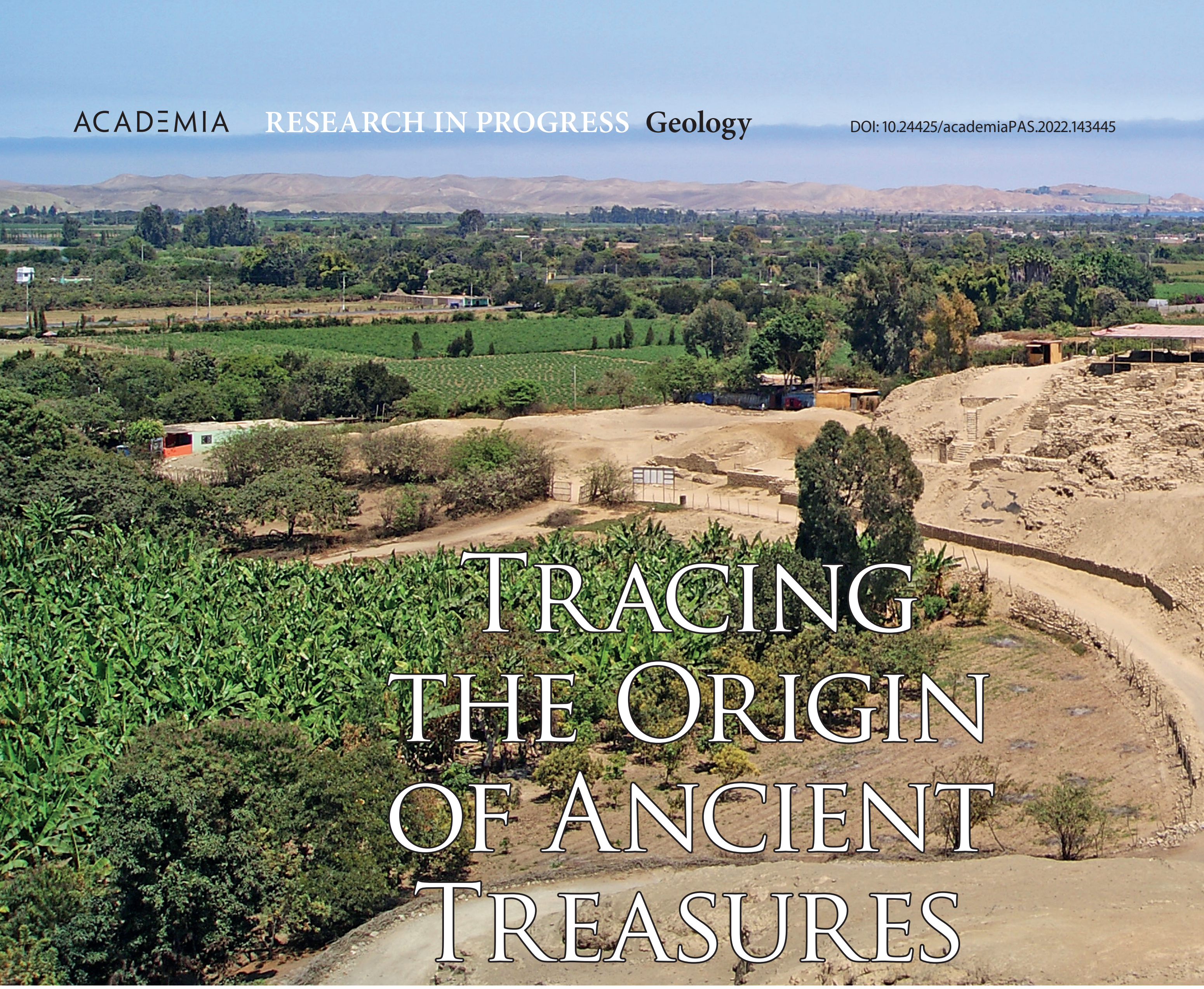
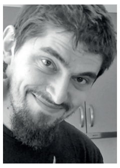
DOI: 10.24425/academiaPAS.2022.143445



Tracing the Origin of Ancient Treasures



Maciej Kałaska, PhD

is a senior research and technical specialist at the Faculty of Geology, University of Warsaw. He deals with the use of chemical, mineralogical, and isotope analyses in archaeology with a special focus on research into the provenance of the material used to create various types of products (ceramics, metal, stone).

mkalaska@uw.edu.pl

Maciej Kałaska

Faculty of Geology, University of Warsaw

Modern-day archaeology is no longer only about dusty excavations, poring over ancient manuscripts, and hunting for treasures. These days, archaeologists are increasingly likely to harness state-of-the-art technologies such as laser scanning and neutron activation, as well as very advanced analytical techniques, including spectroscopic methods. Such approaches make it possible to gain new insights into problems that would seem to be already well-studied, and open up new avenues in the areas of interpretation and research. Modern analytical methods used in such disciplines as archaeology include chemical and isotope analyses of metals (such as lead, copper, and silver), which makes it possible to discern where the ore used to produce a particular metal had originally been mined.

But why is this done, what can this information tell us? One of the most important aspects of archaeology involves reconstructing the network of mutual contacts (the cultural exchange and the movement of goods) between different ancient civilization centers, which allows us to better understand the links between them. In this way, we can also reconstruct trade routes and dependencies between different archaeological sites. To achieve this, we typically try to trace the sources of the materials (such as ores, clay, and wood) that were used to make a specific product or a specific type of products.

One difficult yet very important aspect of efforts to reconstruct such trade links involves determining the origin of the ore used in the process of smelting to produce metals. The difficulty lies in the fact that in a given area there may be many places where ore was mined or continues to be mined for metal smelting, or in the opposite situation – we may have a metal object from a specific archaeological site, but there does not seem to be any mine with this particular type of ore within a radius of, say, 100 km. This prompts us to assume that the metal must have been brought in

Modern research methods, including analyses of chemical elements and isotope ratios of individual elements, can help us unravel mysteries of the past. Studies of metal ore mining activity in ancient South America reveal clues about the economic development of pre-Columbian civilizations across vast areas of the continent

MACIEJ KAŁASKA

The tomb at Castillo de Huarmey with the village of Huarmey visible in the background

from another region, another country, or even another continent. Verifying this assumption requires many detailed analyses of the archaeological object itself and the collection of analogous data on different sources of the ore used to produce the metal in question.

What is lead needed for?

The methods used to find ore mining sites vary. For archaeological objects made of non-ferrous metal alloys (gold, silver, or copper), the only method used for many years involved performing chemical analyses on samples and comparing the findings to the results of the chemical analyses of various types of ores. However, this method had numerous drawbacks: a large area might have had several mines with similar chemical compositions of the ore, so chemical analysis alone did not allow researchers to identify the specific mine that was the source of the ore. Advances in science and technology have more recently resulted in lead isotope ratio analyses being used in conjunction with the traditional chemical analysis. Isotopes of lead have been discovered to be (usually) an excellent tool for ore provenance studies. This results from the fact that a given mine or micro-region (the areas surrounding a particular locality) has its unique record of lead isotope ratios. By taking advantage of this fact and using increasingly accurate chemical analyses, we can determine the location of the source of the ore used for metal smelting or its approximate region of origin with growing accuracy. Such methods work particularly well in Europe, given that it is characterized by

MIŁOSZ GIERSZ

Metal artifacts from the Castillo de Huarmey tomb

Ore currently mined in the region of the Huarmey River Valley

very thoroughly researched ore mining areas, an abundance of chemical and isotopic data, and a wide geochemical variety of individual regions or even mines.

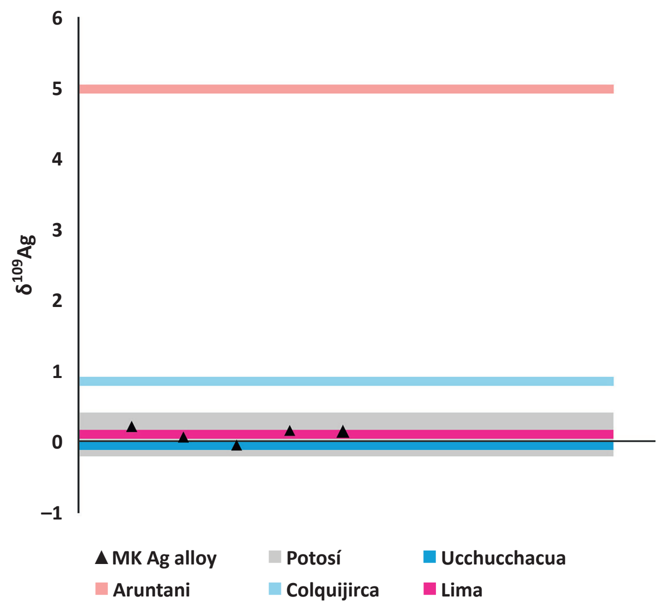
However, when archaeologists seek to determine the origin of an ore used to produce non-ferrous metals in South America, they may run into a very significant problem. As a result of the geological history of South America, its west coast, regarded as the cradle of the great pre-Columbian civilizations and characterized by the greatest abundance of metal deposits, can be divided into four lead isotope provinces. These provinces are elongated in a north-south direction. In each of these vast areas, we can notice little diversity in the record of isotope ratios and the presence of many mines of similar chemical characteristics. Both factors make it very difficult to pinpoint the exact place or micro-region of the origin of a given ore. So far, the most common approach has been to compare data (lead isotope and chemical analyses) from archaeological objects against analogous data from the nearest mine to match the ore mining site to the object.

However, this task becomes problematic when no mines of the metal in question exist or have been discovered in the vicinity of a given archaeological site. Examples include the archaeological site called El Castillo de Huarmey, known for the globally unique find of an unlooted tomb of Wari noblewomen (650–1050 AD). The discovery was made in 2012 by a Polish-Peruvian archaeological mission led by Dr. Miłosz Giersz from the Faculty of Archaeology, University of Warsaw. Objects found in the tomb included gold jewelry and an abundance of artifacts made of silver and copper alloys. Chemical analyses revealed the presence of at least four types of copper alloys and two types of silver alloys at the site. It was also determined that an ore with a different chemical composition was likely used for each of the copper types. This provided the basis for the conclusion that the copper ore came from four different sources. However, there were no documented pre-Columbian ore mining sites in the vicinity of the Castillo de Huarmey site, so no standard methods could be used to determine the provenance of the ore. To do so, researchers analyzed not only lead isotopes but also stable silver and copper isotopes, which are increasingly frequently used in ore provenance studies. They provide information about the type of the ore used (primary or secondary ore) and the geochemical environment (such as sulfide, hydrothermal, or sedimentary ore). Such data make it possible to determine the place of origin of the ore with a greater degree of accuracy.

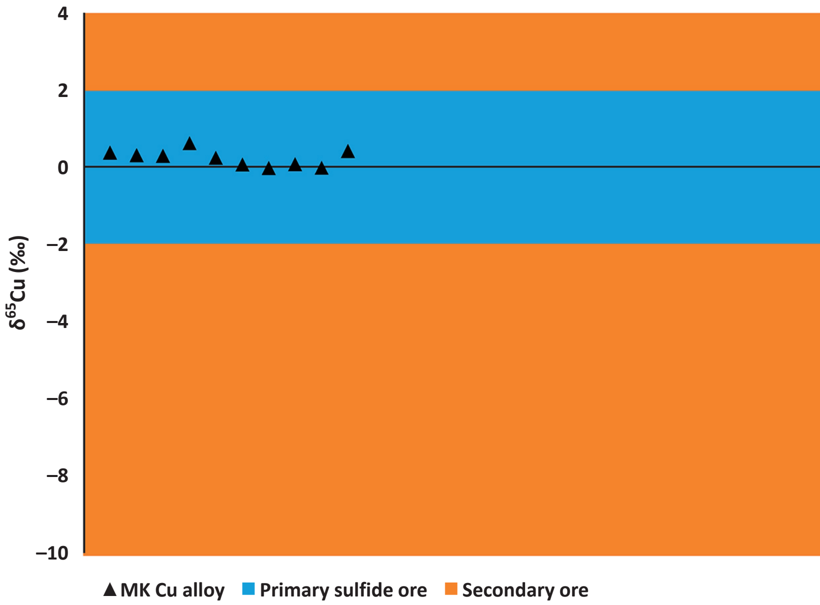
Distant corners of the empire

Isotope analyses (silver and copper isotope ratios) carried out so far on the metal objects from the Castillo de Huarmey site show that a primary sulfide ore was used for both copper and silver alloys. This means that

Entrance to a contemporary mining pit in the Huarmey River Valley



Results of the analysis of the isotopes of silver from the silver objects found at Castillo de Huarmey and analogous results from various silver mines from the Central Andes



Results of the isotope analysis of copper from the copper objects found at Castillo de Huarmey compared against results for primary and secondary ores from copper mines from the Central Andes

we can exclude all surface deposits, which are in most cases secondary deposits. In addition, these findings show that the Wari people were so technologically advanced that they conducted underground mining or quarrying at considerable depths. Analyses of lead isotopes showed that most of the objects came from the borders between three isotope provinces (I, II, and III), only one object (made of copper) was definitely made of ore from Province III, and two objects (made of silver) fit the profile of Province IV. The results were then compared against the findings from specific archaeological sites associated with the Wari culture (Conchopata, Tiwanaku) and the most important silver and copper mining centers, both contemporary and of the pre-Columbian origin. It turned out that most of the artifacts linked to the borders of the three provinces might come from three sources:

1. the mine in Julcani (south of Peru), like the Wari culture objects from Conchopata,
2. the smelting of ore from two or more geochemically different mines, which might distort the results regarding these objects,
3. recycling/remelting of older metal objects.

Options 2 and 3 mean that the isotopic signature is “illegible,” so it is impossible to determine the source of the ore. Option 1, however, clearly points to Julcani as the source of the ore. This would mean that the metal was transported over a distance of more than 750 km from the vicinity of the center of the Wari empire to the distant and important centers of this culture in the north. In addition, it was established that one of the objects was probably made from ores from the region of Potosí or Pulacayo in Bolivia, and correlates very well with isotopic data for metal objects of the Tiwanaku culture from the area of today’s Bolivia. This points not just to an exchange of goods between Wari and Tiwanaku in the border areas: goods brought from the Tiwanaku empire may have been transported to the remote northern borders of the Wari empire.

Lead isotope results obtained for several samples correlate with the findings for ore samples from mines in northern Peru and for rocks from the Huarmey Valley. This would indicate with a greater degree of likelihood more local metal production or an exchange of goods with areas north of the Huarmey province. The last two samples from Province IV were most likely extracted in the south of today’s Peru. Unfortunately, the absence of more accurate data prevents their location from being identified more closely.

Studies of the origin of the ore using lead isotopes supported by silver and copper isotopes point to many different sources of the ore. This may indicate highly developed trade routes between Castillo de Huarmey and the rest of the Wari empire and neighboring cultures. In addition, the data on the types of the ore used show that pre-Columbian cultures in America used more advanced mining methods than we might think. This is because ancient Wari miners built underground mines to obtain primary ores. ■

Further reading:

Pringle H., Clark R., “Untouched: Grave robbers had plundered this ancient Peruvian site for decades. But they missed one royal tomb, hidden for more than 1,000 years,” *National Geographic*, 2014.

Giersz M., Prządka-Giersz P., *Skarby Peru. Królewski grobowiec w Castillo de Huarmey [Treasures of Peru: The Royal Tomb at the Castillo de Huarmey]*, Polskie Towarzystwo Studiów Latynoamerykanistycznych, 2017.

Kałaska M., Druc I.C., Chyla J., Pimentel R., Syczewski M., Siuda R., Makowski K., Giersz M., *Application of electron microprobe analysis to identify the origin of ancient pottery production from the Castillo de Huarmey, Peru, Archaeometry*, 2020, https://doi.org/10.1111/arcm.12581