

Isotopic, mineralogical and geochemical analysis of metal objects from the Castillo de Huarmey tomb and ores obtained in the Huarmey river valley (Peru) will be used to determine the location of exploitation of the raw materials by the Wari Culture.

The aim of the project is to answer the question: “Where did the ore used for making copper and silver objects, through the Wari Culture come from and what type of ore was used for this purpose?” Hence, what could have been the state of mining development in the Wari Culture. In addition, there will be given answers regarding the types of mineralization of ore-bearing veins located in the vicinity of the El Castillo de Huarmey archaeological site and the form of gold and silver present in them, which are still sought after by the local population in this region.

There are several stages planned in the project. The first stage will be the analysis of archaeological material collected from El Castillo de Huarmey. It consists of findings delivered by Dr Milosz Giersz from the Institute of Archeology of the University of Warsaw and ore samples collected in the field, so far. Thin sections of ore fragments will be made, to be studied under the polarizing microscope to obtain their petrographic description and select material for further investigations. The thin sections will be used to acquire chemical maps (FE-SEM-EDS). These will be exploratory analyses, used to select the most interesting places for electron microprobe analyses (EMPA). First, the metals will be analysed on a scanning electron microscope (FE-SEM-EDS) in order to obtain preliminary results of the chemical composition and to find the ore artefacts or inhomogeneity in the alloys. Then, the selected fragments will be analysed under the electron microprobe (FE-EMPA), which will allow us to determine the exact chemical composition of the investigated metals and allow to calculate the conditions prevailing during formation of the studied mineral phases. At the same time analyses of ore fragments will be carried out using a scanning electron microscope (FE-SEM-EDS) to obtain images of the forms and textures of the ore minerals and to determine the variability in their chemical composition. On this basis, an attempt will be made to determine in which minerals and in what form the gold is present. At the same time, X-ray diffraction (XRD) examination of ore fragments will be made to obtain full mineral compositions. An analysis of the chemical composition of ores and metals will also be performed using an Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES). This analysis will be used to determine the content of trace elements and the quantitative content of individual metals in the samples tested. The final stage will be the determination of the ratios of stable isotopes of copper, silver and lead using a multi-array inductively coupled plasma mass spectrometer (MC-ICP-MS) and a comparison of the results obtained with the isotopic results collected by Professor Ryan Mathur from the Peru area. This will allow to extend the scope of exploration to the entire country.

The selection of ore mining sites by ancient civilizations has long been a big unknown for archaeologists. One of the methods that can help to solve this mystery is to use isotopes as the tracers. Until now, the most frequently performed research has been the study of stable lead isotopes, but an analysis of stable isotopes of copper and silver is an equally good tool. In addition to the origin of the ore, it can also help to determine its chemical character. It is a very useful tool, allowing us to discover the stage of technological development achieved by the researched civilization. By combining the isotope data with chemical and mineralogical analyses, we obtain additional, detailed information about the technological advancement of the study people. This information is especially important in the study of pre-Columbian cultures from South America because they did not leave written traces behind, like the Chinese or Egyptians. The only remains after the Culture of Wari are architectural monuments with hieroglyphics, ceramics, metal monuments and fabrics. It is these lines of evidence that we must try to decode to explore the history of these people. An additional factor hindering access to knowledge about the oldest pre-Columbian cultures is the widespread plundering of archaeological sites (tombs, temples), which has been done for hundreds of years, by both Europeans and previous empires. All this makes getting to know these oldest cultures of South America extremely difficult.

The only unlooted tomb of the Wari Culture so far, found at El Castillo de Huarmey is unique on a global scale and provides an extraordinary insight into this culture. The analysis of artefacts will certainly shed light on many aspects of the life of that civilization. Conducting geochemical and mineralogical tests on fragments of metal products will give additional answers to questions relating to the level of development of mining and metallurgy in this period in South America.