

## The future of accelerator technology application for archaeology in Indonesia

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### History

In 1978, R.P. Soejono led the National Centre for Archaeological Research (Puslit Arkenas) to open laboratory of Paleoecology and Radiometry (Palrad) in Bandung. The founding of Palrad has marked the first usage of nuclear technology for archaeological researches in Indonesia. The research activities were ended on July 1, 1992 when their function was transformed into Bandung Archaeological Center.

After the disbanding of Palrad, the National Center for Archaeological Research established cooperation with the Nuclear Research Centre of Yogyakarta (BATAN). They have conducted various studies of radiocarbon dating and elemental analysis on various artifacts, both with X-Ray analysis and neutron activation analysis using the Kartini 250 kW research reactor, in Yogyakarta.

### Recent progress

After the political changes of 1998, most nuclear-based archaeological research was carried out in cooperation with institutions abroad. Carbon dating and stable isotope analysis have been done in the Waikato University, National Museum of Natural History Japan, and Arizona University. Recently uranium series dating was also carried out in collaboration with MNHN France and Griffith University, while luminescence dating was cooperated with Naturalis Biodiversity the Netherland. In addition, research based on X-Ray microtomography was also active in collaboration with AST-RX UMS 2700 CNRS (France) and CENIEH, Burgos (Spain).

### The future

The reorganizing of all research institutions in Indonesia has brought the Puslit Arkenas under the umbrella of National Research and Innovation Agency (NRIA), named as Research Organization of Archaeology, Language, and Literature (RO ALL). NRIA has promoted many collaboration opportunities, and currently RO ALL is planning strategic steps with Research Organization of Nuclear Energy to develop the implementation of accelerator technology for archaeological research and heritage conservation.

- Accelerator Mass Spectrometry

AMS dating laboratory is very important in archaeological research, as they can cover the range of events from hundreds of years up to three million years ago. Laboratories equipped with the AMS method has a very sensitive detection quality, able to detect using a very small sample quantity (less destructive), and the analysis process is very fast (minutes to hours).

- Uranium series laboratory

The U/Th laboratory can analyse dating samples such as fossils, speleothems and other carbonate materials. The laboratory can also perform elemental detection and quantification of material samples, determination of elemental composition in artefact and paleontological raw materials, palaeodietary investigations through Strontium analysis, also traces of human migration by identification on marker elements.

- Archaeo-Chemico and Mineralogical Laboratory

The main purpose of this laboratory is for the characterization of materials, based on the study of their chemical composition and mineralogy, as well as their vibrational and thermal analysis. This type of laboratory is supporting research in geology, archaeology, heritage, chemistry and pharmaceuticals, construction, civil engineering, and nanomaterials.

- Luminescence laboratory

Luminescence dating is based on the ability of quartz and feldspar minerals for determining the age of sites, the age of rock formations and sedimentation environments, determination of sedimentation rates and their continuity, measurement of Beta and Gamma dose rates in sediments, as well as of Gamma's natural dose level at archaeological site.

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