

## Scientific approaches in characterization of Ayutthaya gold and gemstones artifacts

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More recently, ancient gold sites have been discovered in many European countries and are not limited to other parts of the world. The earliest gold artifacts were dated to approximately 4,600 BP. Apart from date determination; a number of ancient gold artifacts were analyzed using available technology to address variety of questions. In general, the best practice on ancient artifact analysis involves delicate and complicated strategies that need strong collaboration between scientists, archaeologists, and curators. Like elsewhere, due to the precious appearance of gold, some original artifacts are disappeared beforehand of authority body. Therefore, the quantity of registered gold artifacts is only a small part of them. Besides, the scientific approach such as nuclear and radiation techniques are difficult to consider as an excellent tool for cultural heritage study.

In Thailand and Southeast Asia countries are well recognized in the past as “Suvannabhumi” which its meaning is “the golden land”. Unfortunately, the scientific approach on ancient gold artifacts in Thailand is rare. Due to MOU between Thailand Institute of Nuclear Technology (TINT) and Fine Arts Department (FAD) signed in 2013, a number of research projects have been conducted continuously. TINT provides available analytical techniques for cultural heritage study including conventional radiocarbon dating, TL/OSL dating, elemental analysis by NAA, XRF, and ICPMS, XRD, autoradiography, radiography, tomography with X-ray, gamma ray and neutron. Majority of research projects emphasize on the establishment of elemental composition database of tangible Thai cultural heritage. The dataset is then integrated with other relevant information such as historical records and oral traditions. The prioritized artifacts in the past couple of years include ancient gold ornaments at Chao Sam Phraya National Museum in Ayutthaya province, bronze sculptures from different locations displayed at Bangkok National Museum and temples throughout Thailand. Nowadays, TINT provides consultation on authentication of valuable objects such as gold artifacts, Buddha sculptures, paintings, stone inscriptions, and glass beads.

The analysis of ancient gold ornament project was initiated under fair agreements between TINT and FAD in 2016. Until now, total of 389 gold ornaments which 73% are samples from Wat Ratchaburana located in Ayutthaya historical park, a UNESCO World Heritage Site, were analyzed onsite by portable XRF. Besides, gemstone and decoration materials were studied in complementary with Raman spectrometry, polariscope and microscope by gemstone experts at TINT laboratory. The results indicate unique character of gold ornaments manufactured 600 years ago. The majority of Ayutthaya gold artifacts made of 75-95% of Au and the remaining elements are silver, copper, tin, lead and iron. Some interesting elements such as iridium may be used to indicate imported raw materials. This study employed a principal component analysis software (PCA) to interpret the elemental profiles of ancient gold samples. The linear correlation between gold and silver concentrations suggests electrum of gold that probably used in Ayutthaya gold manufacturing. The results reveal variety of gemstones decorated on gold ornaments and can be further studied to understand provenance of those cultural artifacts as well as the inter connection among the regions.

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