

‘Fragile old man’: Mexico and France save a 2000-year-old sculpture using nuclear techniques

By Aabha Dixit

“In spite of its unstable condition, the experts from the Mexican–French team felt that there was hope that advanced nuclear techniques could possibly save the 2000-year-old fragile old man.”

— Alejandra Alonso-Olvera, senior restorer, Department of Conservation, National Institute of Anthropology and History, Mexico

During an excavation in 2001 in Becán, a Maya civilization site located in Campeche State in south-eastern Mexico, a 2000-year-old wooden sculpture was unearthed causing a buzz in Mexico’s archaeological community. The wooden statue was tucked away deep beneath a collapsed tomb. It was the first ever wooden object found that could be reliably dated to the early classical Mayan period, but was slowly decaying, with many fragments broken off.

With the help of nuclear technology, and assistance from France, scientists have revived it to its previous glory. The statue is now on display at the Campeche museum, along with other objects of Mayan art.

After careful examination, the wooden artefact was identified as a male. Several areas of the sculpted body were heavily eroded, and fragments were missing. The ankles and feet of the sculpted character were particularly fragile because of their narrow shape, making these areas extremely weak for supporting the total mass load, said Alejandra Alonso-Olvera, senior restorer at the Department of Conservation, National Institute of Anthropology and History, who was involved in the restoration project.

“In spite of its unstable condition, caused by context disturbance, ageing, mechanical abrasion and biological decay, the experts from the Mexican–French team felt that there was hope that advanced nuclear techniques could possibly save the 2000-year-old fragile old man,” she added.

What did he look like?

Explaining the characteristics of the ancient Maya sculpture, Alonso-Olvera said that it had been carved out of a single wooden block, with a height of 21.5 cm and a width at its base of 17.5 cm. The sculpture had no facial features and the lower parts of the arms were missing, she added. A closer examination of the sculpture revealed that there were illustrations on several parts of the body, and that the base had been painted.

The Mexicans contacted the Atelier Régional de Conservation Nucléart institute (ARC-Nucléart) in Grenoble, France, part of the French Atomic Energy Commission, to seek scientific and technical assistance in restoring the old sculpture. ARC-Nucléart is renowned for its pioneering efforts in conservation and protection of ancient artefacts using gamma irradiation processes.

“It was an outstanding collaborative research opportunity for both institutions,” said Quoc-Khôi Tran, a senior expert in the field of gamma irradiation at ARC-Nucléart, which provided training in conservation and

‘Fragile old man’



Before



After

Left: The ‘fragile old man’ prior to gamma ray irradiation.

Right: The preservation has saved the ancient sculpture.

(Photos: courtesy of Quoc-Khôi Tran, ARC-Nucléart)

The irradiation treatment using gamma rays was carried out at the National Institute for Nuclear Research’s irradiation facility near Mexico City. This technology — using gamma polymerization technology on archaeological wooden objects (see box) — was a ‘first’ for Mexico’s conservation efforts. The conservation process for this unique find has provided Mexico with the necessary expertise on a state-of-the-art technology that can conserve aged artefacts of historical relevance.

restoration methods using gamma irradiation processes to experts from Mexico.

Microscopic observations through laboratory investigations were initially undertaken only at the base level of the delicate artefact.

“Touching the main sculptured piece was too tricky due to its fragile state,” said Alonso-Olvera. This study was necessary to assess the type of wood, the colour, the extent of damage by biological organisms as well as moisture content.

Fighting fungi

These investigations determined that the wood was a tropical hardwood — ziricote — that is native to the Yucatan Peninsula. Ziricote is naturally resistant to fungi or attack by other wood-destroying microorganisms, she added. However, during the investigations, the presence of hyphae, a form of fungus that grows within the cells of the wood, was noticed, Alonso-Olvera explained.

The archeologists decided to subject the wooden figurine to gamma radiation polymerization treatment, which would kill the fungus and protect the sculpture from any further deterioration. This method would stabilize the wood through the use of a radiation-curing consolidant, and also restore the colour.

The irradiation treatment using gamma rays emitted by cobalt-60 sources was applied at



relatively low dose rates in order to keep the temperature within the wood under control (at around 40–50°C) during the polymerization process. The gamma ray dose rates had to be carefully monitored each time to ensure proper consolidation of the wood, Tran explained.

Close collaboration between Mexican and French specialists was critical to the success of this project, said Alonso-Olvera.

The IAEA, in collaboration with ARC-Nucléart, supports Member States in using irradiation technology for the preservation of historical items. In addition, a number of IAEA training courses are conducted to widen awareness of the use of nuclear science and techniques, and to build irradiation preservation capacities that can help save distinctive archaeological items that help to explain the course of a country’s history.

Preparing the support frame for the Maya sculpture for the resin impregnation.

From left to right : the Mexican technical team, Alejandra Alonso-Olvera and Quoc-Khôi Tran

(Photos: courtesy of Quoc-Khôi Tran, ARC-Nucléart)

THE SCIENCE

Conserving degraded wooden artefacts using gamma radiation polymerization treatment

The use of gamma radiation polymerization for consolidation of degraded wooden artefacts is based on the principle that certain liquid resins (such as unsaturated polyester or acrylic resins) can be in-situ polymerized into solid polymers inside the pores of wood through exposure to radiation, thereby strengthening the structure of the wood.

First, through a thorough cleaning of the surface, any solid particles that cover the artefact are removed using soft brushes. In the next step, regular diffusion of a liquid polymerizable resin within the structure of the wood is achieved by a vacuum and

pressure process also known as pressure impregnation.

The impregnation process involves filling the pores of wood with a material that on in-situ polymerization by gamma radiation will strengthen the structure of the wood without causing it to contract or come apart. The consolidated wooden artefact is therefore much less sensitive to variations in humidity levels than untreated wood. After irradiation, other restoration procedures, such as gluing, reconstruction and filling gaps, are used to restore the artefact.