Air bubbles in ancient glass reveal production technique

March 26 2018

Portland vase. Credit: Carole Raddato

An artist, a physicist and a classicist at ANU may have together overturned a 2,000-year old theory about Roman glass making.

Experts in the area are debating whether a decorative glass making technique known as cameo glass was blown or cold-pressed.

At stake is the origin of the British Museum's most famous example of Roman glass – the Portland Vase.

Its secrets could lie in air bubbles trapped within the glass of other ancient Roman artefacts.

The bubbles could prove experts have been wrong for hundreds of years about how the glass was made.

Associate Professor Richard Whiteley, a Master Glass Artist at the ANU School of Art and Design, is researching this issue by examining fragments of Roman cameo glass with a specialised scanner.

He is suggesting archaeologists, historians and museum curators have for centuries wrongly classified this glass, from the period of around 30BC–50AD, as blown glass.

And that includes the famous Portland Vase – hence the controversy about his view.

Unsurprisingly, he caused a stir when he presented his point of view to an historical glassworks conference at the British Museum in London late last year.

He was already known and respected internationally for his glass artworks.

He says his research, including his handworked glass, strongly indicates the Roman cameo glass was not blown, but was made by a cold-pressing process now known as pâte de verre.

In this method a design for a glass vessel was formed in clay, with fine decorative detail carved in relief. A plaster mould would then be taken and the clay removed, leaving the decorative features indented into the mould.

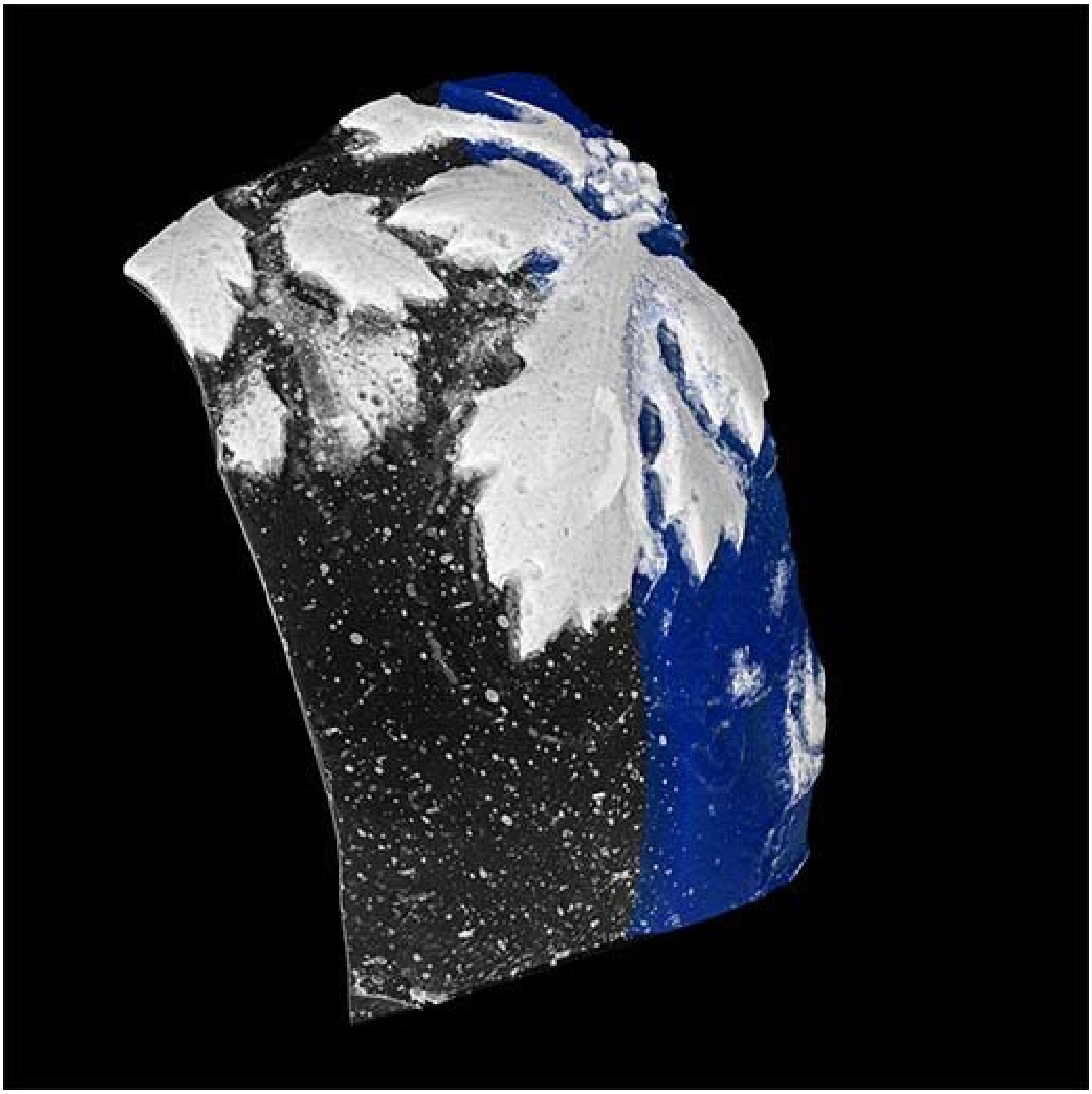


Image of the Roman cameo glass rendered in Drishti, an open source software created and designed at ANU by Dr Ajay Limaye, National Computational Infrastructure. Credit: Australian National University

Whiteley believes cold-granulated white glass particles were then applied in a paste into the mould to fill the decorative indentations, and were possibly painted on in layers.

A molten boule of blue glass was then pressed and worked into the mould, fusing the white glass particles and design to the surface of the blue glass.

Whitely says when he arrived at the British Museum, the convenor of the conference – a significant figure in historical glass research – greeted him with: "It's going to be an interesting conference for you, Richard!"

"She said that because the position our research team at ANU has taken is against the accepted opinion that Roman cameo glass is blown – but she was very supportive and open to my ideas," he says.

The cross-campus research project used an ANU-designed scanner that gives a microscopic three-dimensional X-ray view of the internal structure of materials.The images revealed for the first time distortions of air bubbles trapped in both the blue and white layers of Roman glass, their shape bearing witness to the motion of the molten glass when the object was formed more than 2,000 years ago.

Director of the Research School of Physics and Engineering Professor Tim Senden says researchers knew it would be an exciting moment when they saw the first images.

"But the data was much more revealing than we could have imagined," he says.

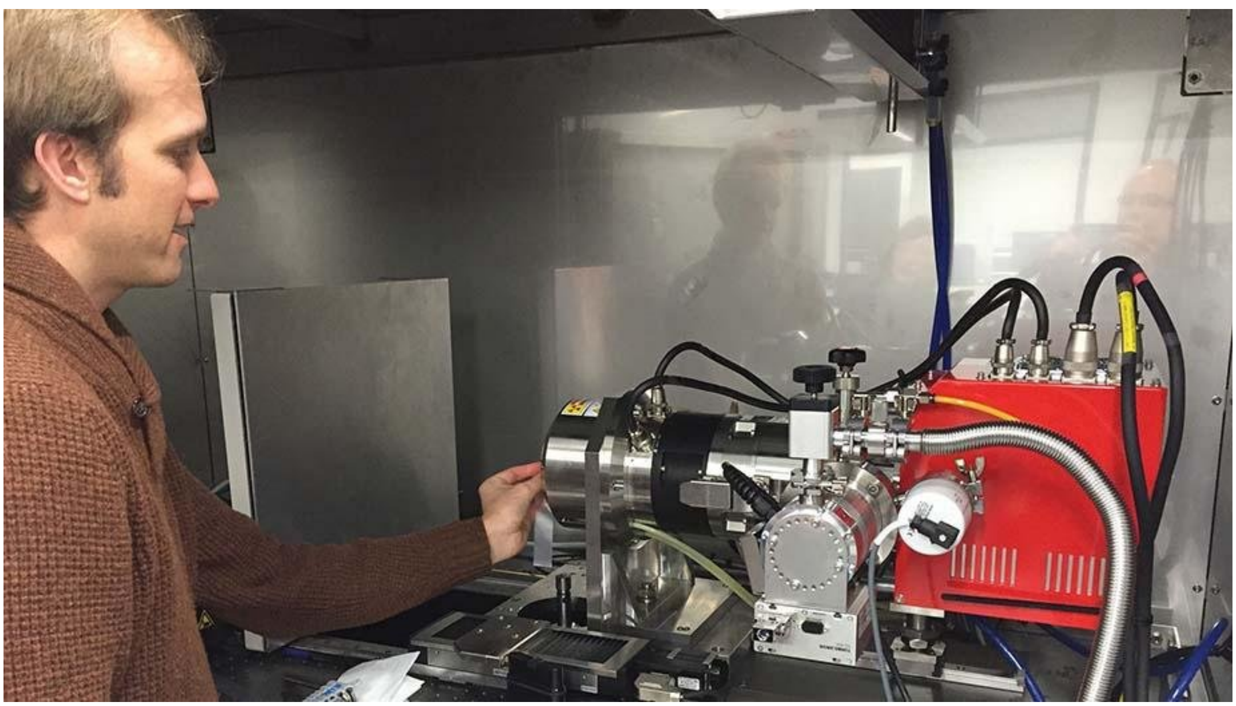
"Artist Erica Seccombe and I were watching this exquisite 3-D data evolve and revolve on the screen and we could see all these minute hidden details just leap out at us – we knew we were seeing something special.

"The bubbles really held the key – Richard's working hypothesis was that this glass in its molten form was sheared and rotated around an internal mould.

"In such a process you can't help but entrain some air and those bubbles distribute themselves from the surface of the mould and into the bulk.

"In effect they are messages about the direction and intensity of the historic patterns of fluid flow.

"So as the molten boule of glass is moved, these bubbles distort and then the glass cools, leaving these distorted bubbles in place – that was the landmark for us."



Credit: Australian National University

Whiteley knows from practical experience that air bubbles formed in blown glass are often elongated, but says the bubbles in the ANU fragment were so radically distorted that they appeared chaotic and demonstrated a significant turbulence in the application of the blue glass.

"I remember the moment I saw it. I said: "Oh my God, this is extraordinary, because there were these bubbles, squashed flat on the back of the white glass, which you get with a pressing motion."The most striking thing about this particular bubble set was not its size or its flatness, but we found a section where the white granules had fused into the blue glass – the movement of the white flecks is consistent with them being heated from behind."

Whiteley says he knew his paper would cause a controversy, but it was still very well received by the international convention of experts.

"Across the board it generated a good deal of debate throughout the conference," he says.

"The calibre and fidelity of the scans and the detail they reveal alone made an excellent contribution to the conference and research for the sector."

Now Whiteley plans to recreate a vessel like the Portland Vase using pˆate de verre and in the process revive a technique that has been lost for 2,000 years.

"I would say without question there were processes the Romans were using that we have no idea about, that have been lost over the centuries," he says.

"They were extraordinary technicians and innovators and I believe there are several techniques that we don't know about or that have been attributed to other processes."

He acknowledges a German artist Rosemarie Lierke came to a similar conclusion in the 1990s, but her research was not accepted.

"It's not about proving people wrong, it's about correcting the historical record and reviving and restoring a technique lost for over 2,000 years," he says.

Provided by Australian National University