



Strictly embargoed:

2:00 pm U.S. Eastern Time Wednesday, 09 January 2019

Illuminating women's role in the creation of medieval manuscripts

Analysis of the fossilized dental plaque of a medieval woman reveals lapis lazuli, suggesting she was an accomplished painter of illuminated manuscripts.

An international team of researchers led by the Max Planck Institute for the Science of Human History and the University of York have revealed direct evidence of medieval women's involvement in the production of illuminated manuscripts. Lapis lazuli in the dental calculus of a woman buried at a 12th-century German monastery suggests that she created richly illustrated religious texts.

During the European Middle Ages, literacy and written texts were largely the province of religious institutions. Richly illustrated manuscripts were created in monasteries for use by members of religious institutions and by the nobility. Some of these illuminated manuscripts were embellished with luxurious paints and pigments, including gold leaf and ultramarine, a rare and expensive blue pigment made from lapis lazuli stone.

In a study published in *Science Advances*, an international team of researchers led by the Max Planck Institute for the Science of Human History and the University of York shed light on the role of women in the creation of such manuscripts with a surprising discovery—the identification of lapis lazuli pigment embedded in the calcified dental plaque of a middle-aged woman buried at a small women's monastery in Germany around 1100 AD. Their analysis suggests that the woman was likely a painter of richly illuminated religious texts.

A quiet monastery in central Germany

As part of a study analyzing dental calculus – tooth tartar or dental plaque that fossilizes on the teeth during life – researchers examined the remains of individuals who were buried in a medieval cemetery associated with a women's monastery at the site of the Dalheim in Germany. Few records remain of the monastery and its exact founding date is not known, although a women's community may have formed as early as the 10th century. The earliest known written records from the monastery date to AD 1244. The monastery is believed to have housed approximately 14 religious women from its founding until its destruction by fire following a series of fourteenth-century battles.

One woman in the cemetery was found to have numerous flecks of blue pigment embedded within her dental calculus. She was 45-60 years old when she died around AD 1000-1200. She had no particular skeletal pathologies, nor evidence of trauma or infection. The only remarkable aspect to her remains was the blue particles found in her teeth. "It came as a complete surprise – as the calculus dissolved, it released hundreds of tiny blue particles," recalls co-first author Anita Radini of the University of York. Careful analysis using a number of different spectrographic methods – including energy dispersive X-ray spectroscopy (SEM-EDS) and micro-Raman spectroscopy – revealed the blue pigment to be made from lapis lazuli.

A pigment as rare and expensive as gold

"We examined many scenarios for how this mineral could have become embedded in the calculus on this woman's teeth," explains Anita Radini. "Based on the distribution of the pigment in her mouth, we concluded that the most likely scenario was that she was herself painting with the pigment and



likely licking the end of the brush while painting,” states co-first author Monica Tromp of the Max Planck Institute for the Science of Human History.

The use of ultramarine pigment made from lapis lazuli was reserved along with gold and silver for the most luxurious manuscripts. “Only scribes and painters of exceptional skill would have been entrusted with its use,” says Alison Beach of Ohio State University, a historian on the project.

The unexpected discovery of such a valuable pigment so early and in the mouth of an eleventh-century woman in rural Germany is unprecedented. While Germany is known to have been an active center of book production during this period, identifying the contributions of women has been particularly difficult. As a sign of humility, many medieval scribes and painters did not sign their work, a practice that especially applied to women. The low visibility of women’s labors in manuscript production has led many modern scholars to assume that women played little part in manuscript production.

The findings of this study not only challenge long-held beliefs in the field, they also uncover an individual life history. The woman’s remains were originally a relatively unremarkable find from a relatively unremarkable place, or so it seemed. But by using these techniques, the researchers were able to uncover a truly remarkable life history.

“She was plugged into a vast global commercial network stretching from the mines of Afghanistan to her community in medieval Germany through the trading metropolises of Islamic Egypt and Byzantine Constantinople. The growing economy of 11th-century Europe fired demand for the precious and exquisite pigment that traveled thousands of miles via merchant caravan and ships to serve this woman artist’s creative ambition,” explains historian and coauthor Michael McCormick of Harvard University.

“Here we have direct evidence of a woman, not just painting, but painting with a very rare and expensive pigment, and at a very out-of-the way place,” explains Christina Warinner, senior author on the paper. “This woman’s story could have remained hidden forever without the use of these techniques. It makes me wonder how many other artists we might find in medieval cemeteries – if we only look.”

Title: Medieval women's early involvement in manuscript production suggested by lapis lazuli identification in dental calculus

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Publication: *Science Advances*, DOI:

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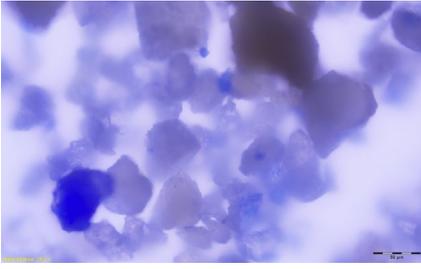
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Thumbnail	File name, caption and credits
	<p><i>File name:</i> Dalheim.jpg</p> <p><i>Caption:</i> Foundations of the church associated with a medieval women's religious community at Dalheim, Germany.</p> <p><i>Photo credit:</i> Christina Warinner</p>
	<p><i>File name:</i> B78_calculus.JPG</p> <p><i>Caption:</i> Dental calculus on the lower jaw a medieval woman entrapped lapis lazuli pigment.</p> <p><i>Photo credit:</i> Christina Warinner</p>
	<p><i>File name:</i> Lazurite_in_calculus.jpg</p> <p><i>Caption:</i> Magnified view of lapis lazuli particles embedded within medieval dental calculus.</p> <p><i>Photo credit:</i> Monica Tromp</p>
	<p><i>File name:</i> Lapis_lazuli.png</p> <p><i>Caption:</i> During the European Middle Ages, Afghanistan was the only known source of the rare blue stone, lapis lazuli. Lapis lazuli contains different minerals that contribute to its unique appearance, including lazurite (blue), phlogopite (white), and pyrite (gold).</p> <p><i>Photo credit:</i> Christina Warinner</p>

	<p><i>File name:</i> Lapis_stones.png</p> <p><i>Caption:</i> Mined in Afghanistan, lapis lazuli was traded overland to cities in the Levant and Egypt, from where it was shipped to Venice, the major port of entry into Europe. From its source in the Badakhshan mines of Afghanistan, the lapis lazuli analyzed in this study travelled more than 6,000 kilometers to reach its final destination at a small women’s religious community in Dalheim, Germany.</p> <p><i>Photo credit:</i> Shelly O’Reilly</p>
	<p><i>File name:</i> Lapis_lazuli_pigment.png</p> <p><i>Caption:</i> Lapis lazuli pigment, also known as ultramarine, was among the most expensive artist materials of the European Middle Ages. Ground and refined from lapis lazuli stone, the pigment was used to depict the heavens and the robes of the Virgin Mary.</p> <p><i>Photo credit:</i> Shelly O’Reilly</p>
	<p><i>File name:</i> Blue_paints.png</p> <p><i>Caption:</i> Few blue pigments were known to the European medieval painter: lapis lazuli, cobalt smalt, azurite, cuprorivaite, malachite, and vivianite. However, among these, only lapis lazuli and azurite were widely used, and lapis lazuli was by far the most prized.</p> <p><i>Photo credit:</i> Shelly O’Reilly</p>
	<p><i>File name:</i> Lapis_lazuli_graphic.png</p> <p><i>Caption:</i> Depiction of the proposed method of incorporation of lapis lazuli pigment into the dental calculus of an early woman – likely an artist – buried in a medieval cemetery at the site of Dalheim, Germany.</p> <p><i>Photo credit:</i> Shelly O’Reilly, Christina Warinner, and Monica Tromp</p>