

Highlights of Analytical Sciences in Switzerland

Division of Analytical Sciences

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Age and Provenance Analysis from Micrograms of Artwork Pigments

Stefan Kradolfer^{*a}, Laura Hendriks^b, Tiziana Lombardo^c, Vera Hubert^c, Markus Küffner^d, Narayan Khandekar^e, Irka Hajdas^b, Bodo Hattendorf^a, Arno Synal^b, and Detlef Günther^a

^{*}Correspondence: S. Kradolfer^a, E-mail: stefan.kradolfer@inorg.chem.ethz.ch.
^aDepartment of Chemistry and Applied Biosciences, ETH Zurich, Vladimir-Prelog-Weg 1, CH-8093 Zurich; ^bDepartment of Physics, ETH Zurich, Otto-Stern-Weg 5, CH-8093 Zurich; ^cLaboratory for Conservation Research, Collection Centre, Swiss National Museum, Lindenmoosstrasse 1, CH-8910 Affoltern am Albis; ^dSwiss Institute for Art Research (SIK-ISEA), Zollikerstrasse 32, CH-8008 Zurich; ^eStraus Center for Conservation and Technical Studies, Harvard Art Museums, 32 Quincy Street Cambridge, MA 02138, USA

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Generally, it is possible to make a lot of money in the business of selling art, and art forgery is a direct consequence. However, no art buyer wants to be fooled, thus in the puzzle of artwork authentication the demand for scientific evaluation is continuously rising. Isotopic analysis is a very promising approach to tackle these problems by providing insights into the age and the provenance of specific materials. In this study, we focused on lead white ($2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$), a widely used pigment from ancient times up till the middle of the 20th century. Accelerator mass spectrometry (AMS) allows us to measure the ¹⁴C age of the pigment carbonate anion, while multi-collector inductively coupled plasma mass spectrometry (MC-ICPMS) yields highly

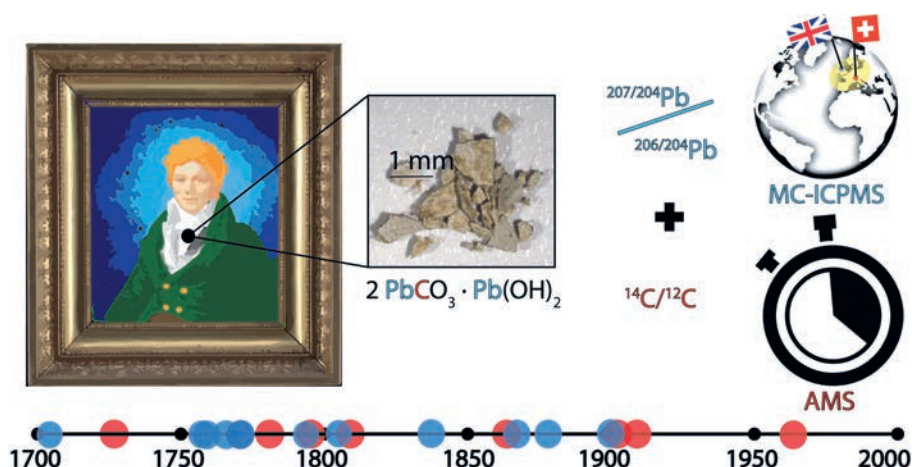
precise lead isotope ratios for a geographical classification, as shown by Fortunato *et al.* This study had only become possible due to recent advances in AMS allowing accurate age determination from μg-levels of carbonate – hereby allowing to minimize the sample size.

Twenty paintings with signed dates covering the 17th up to the 20th century, originating either from Switzerland or Great Britain, were investigated. Sample amounts ranging from a few hundred μg's to a maximum of 1.5 mg allowed the Pb isotope ratios of the carbonates as well as the corresponding ¹⁴C ages of both the carbonates and the oil binders to be determined. The results of all paintings, except one, allowed the conclusion that the used pigment was produced following a traditional production process incorporating atmospheric CO₂ and allowed to give a time range for the production of the used pigment. The lead isotope measurements showed no clear distinction between the artworks' origins but corresponded to lead ore deposits located in Europe. **In conclusion, these results illustrate the great potential of combining isotope analyses from a minute piece of lead white in the mg-range, allowing for insights into its age and provenance.**

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References

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Lead white samples are taken directly from paintings and further analyzed by AMS (radiocarbon age) and by MC-ICPMS (lead isotope signature). The ¹⁴C ages allow conclusions to be drawn about the production process of the pigment and give a time-range of its production. The lead isotope signatures are used for geographical classification and are in agreement with European ore sources.

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Please contact: Dr. Veronika R. Meyer, Unterstrasse 58, CH-9000 St. Gallen
 Tel.: +41 71 222 16 81, E-mail: VRMeyer@bluewin.ch