# Supporting information for "Dual Isotope System Analysis of Lead-white in Artworks"

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This PDF file includes the supporting information divided in 3 sections:

1. Sampling and material characterization
   Figures S-1 and S-2 provides an overview of the sampling location and sampled amount of material from Swiss artist objects, while Figure S-3 displays the canvas clipping of the British objects.
   Material characterization data for objects from Swiss respective British artists are reported in Table S-1 and Table S-2 respectively.
2. $^{14}$C-data
   Table S-3 and Table S-4 contain an overview of the radiocarbon data measurements
3. Lead isotope measurements
   Table S-5 provides the parameters for the digestion of the remaining material after $^{14}$C dating.
   Table S-6 and S-7 are giving the ICPMS parameters, Q-ICPMS and MC-ICPMS
   Table S-8 and S-9 are providing data concerning the long-time stability of the MC-ICPMS data
   Fig. S-4, S-5 and S-6 are showing the influence of additional matrices in the samples as $CaCO_3$ load respectively acid and oil additives.
   Table S-10 reports all the numeric lead isotope ratio results of the samples from Swiss and British artists.
   Figure S-7 shows the $^{206}Pb/^{204}Pb$- vs. $^{207}Pb/^{204}Pb$-data for all the samples (Tab. S-10)
   Figure S-8 shows the calculated LIRI-values against the signed date for all the samples
   Figure S-9 shows the $^{207}Pb/^{206}Pb$- vs. $^{208}Pb/^{206}Pb$-data for all the samples, separated based on the century of their signed date.

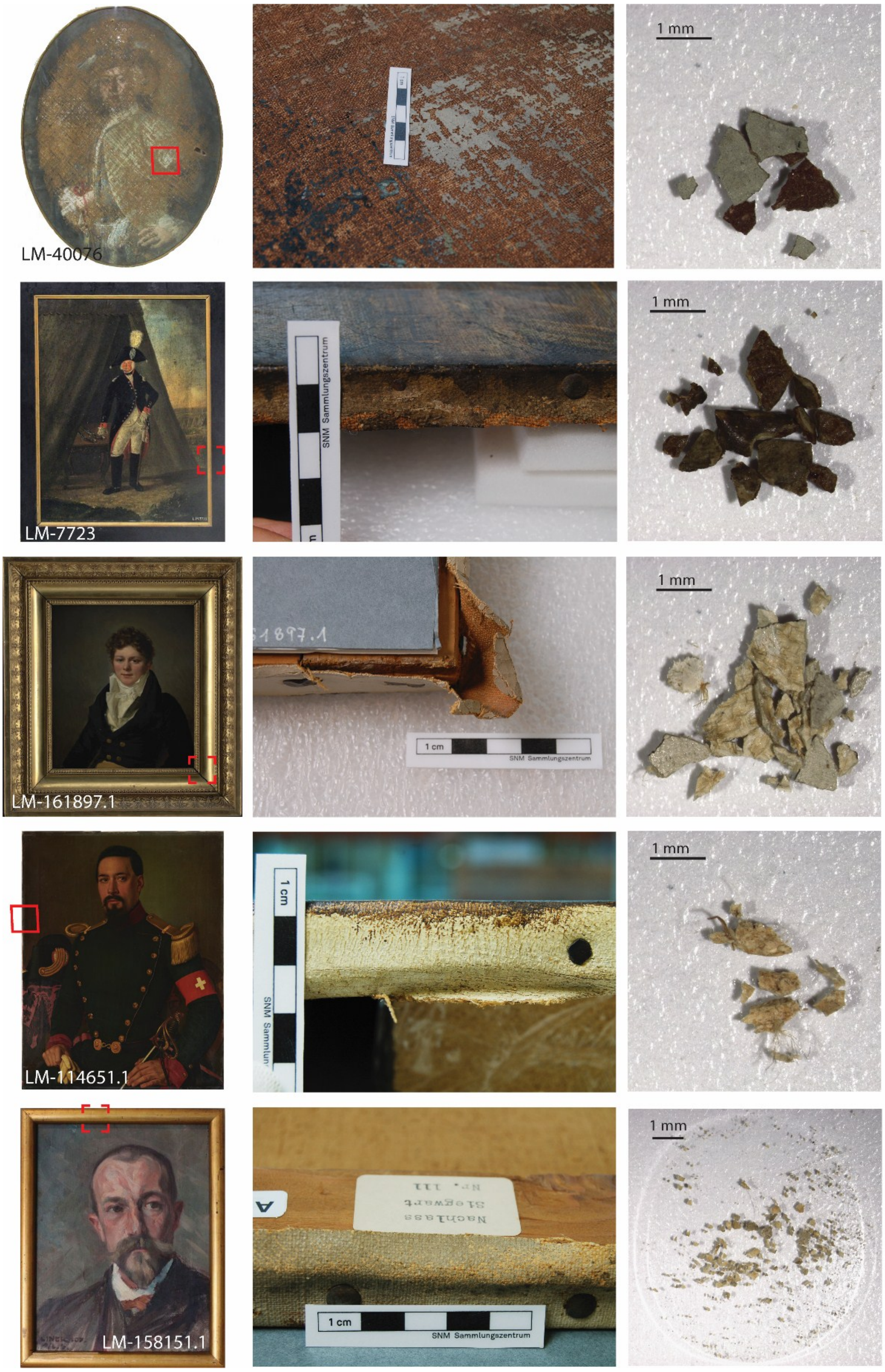



*Figure S-1: Sampling overview from the Swiss objects. (Left) Picture of the paintings (Copyright: Swiss National Museum) where the red box indicates the sampling location, (middle) close-up of the sampling area, (right) actual sampled amount of material.*


*Figure S-2 Sampling overview from the Swiss objects (continued). (Left) Picture of the paintings (Copyright: Swiss National Museum) where the red box indicates the sampling location, (middle) close-up of the sampling area, (right) actual sampled amount of material.*

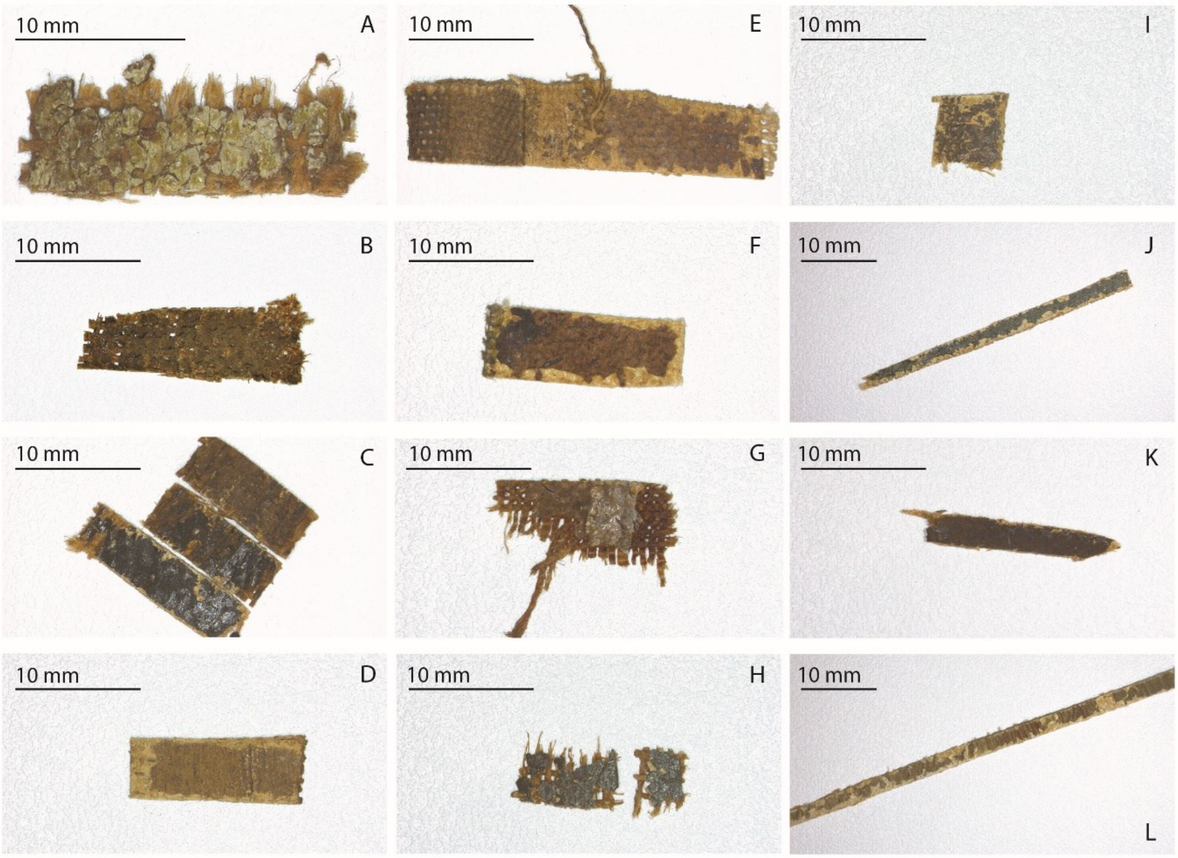



*Figure S-3 Sampling overview from the canvas tacking margins belonging to paintings by British artists and provided by the Harvard Art museums. (A) Marco Ricci, (B) PH Hill, (C) Joshua Reynolds, (D) Richard Wilson, (E) Georges Romney (a), (F) Georges Romney (b), (G) Samuel Alken, (H) John Francis Sartorius, (I) John Warkup Swift, (J) William Meadows, (K) Henry Tanworth Wells, (L) Sir Arthur Stockdale Cope.*

Material characterization was conducted by combining XRF, FTIR and Raman spectroscopy. XRF analyses were carried out directly on the paintings at the Collection Centre (SNM, Affoltern a. A., Switzerland) using a Bruker AXS ARTAX 800 system equipped with a Rh target and achieving an excitation spot of 80 µm. Spectra were collected with the following settings: generator voltage 50 kV, current 600 µA, ambient conditions, and acquisition time 120 s (Bruker, Karlsruhe, Germany). FTIR analyses were conducted in ATR mode on a Spotlight 200i FTIR spectrometer (Perkin Elmer, Massachusetts, USA). The acquisition spectral range covered 4000–580 $cm^{-1}$ with a resolution of 4 $cm^{-1}$ and 8 scans. The evaluation and interpretation of the FTIR spectra was based on in house reference database, as well as the online IRUG spectral database[1] and published data (Vahur et al., 2016)[2]. Raman measurements were performed on an ARAMIS Raman spectrometer (Horiba Jobin Yvon, Germany) equipped with a microscope (Olympus BX41) which allows visualizing the sample. The spectra were acquired with a 785 nm laser source (Laser diode controller Pilot PC500, Sacher Lasertechnik, Germany) and recorded using a laser power between 3 to 15 mW on sample, 100x magnification, 600 g/mm grating and measurement time between 30 and 200 s. Raman spectra evaluation was based on published data[3–8] Table 1 and 2, material characterization for samples

*Table S-1 Summary of the material characterisation results conducted on the Swiss paintings.*

| Code | Title/object - artist | Date | Method | Laboratory data | Interpretation |
|---|---|---|---|---|---|
| LM-161897 | Eric Magnus Louis Grand Hauteville By anonymous after Amélie Munier Romilly | 1813 | XRF | Pb | Lead white |
| | | | FTIR | 3535, 1387, 1045, 837, 678 | Lead white (basic) |
| | | | | 2922, 2851, 1736, 1616, 1164, 772 | drying oil |
| | | | | 1511 | lead stearate |
| | | | | 2517, 1798, 1387, 1092, 872, 712 | Calcium carbonate |
| | | | | 1616, 772 | Calcium oxalate · $H_2O$ |
| | | | Raman | 1050, 102 | Lead white (basic) |
| | | | | 1388, 1597 | Carbon black |
| | | | | 143, 282 | Litharge/Massicot/Naples yellow |
| LM-114651 | Adolphe Morand By Jh. Loretti | 1863 | XRF | Pb, Ca, Fe | Lead white, calcium carbonate, earth pigment |
| | | | FTIR | 3535, 1391, 1045, 833, 679 | Lead white (basic) |
| | | | | 2923, 2852, 1734, 1167, 854, 768 | drying oil |
| | | | Raman | 56, 70, 102, 151, 1053 | Lead carbonate |
| | | | | 988 | Barium sulfate |
| | | | | 145 | Litharge/Massicot/Naples yellow |
| LM-158151 | Hugo Siegwart By Carl August Liner | 1907 | XRF | Pb, Zn, Ca, Fe | Lead white, calcium carbonate, earth pigment |

| | | | | | |
|---|---|---|---|---|---|
| | | | FTIR | 3530, 1395, 1053, 846, 670, | Lead white (basic) |
| | | | | 3290, 1624 | Proteinous material |
| | | | | 2920, 2851, 1734, 1160, 1115, | Drying oil |
| | | | | 1023, 605 | Bone black |
| | | | | 2515, 1798, 1395, 871, 712 | Calcium carbonate |
| | | | | 1624, 773 | Calcium oxalate · $H_2O$ |
| | | | Raman | 546 | Lazurite |
| | | | | 152, 1085 | Calcite |
| LM-161803 | Preliminary design for "die Wiege der Eidgenosssenschaft" By Charles Giron | 1899-1902 | XRF | Pb, Zn, Ca, Fe | Lead white, calcium carbonate, earth pigment |
| | | | FTIR | 3538, 1393, 1047, 835, 678 | Lead white (basic) |
| | | | | 2926, 2853, 1734, 1709, 1241, 1163, 1082 | Drying oil |
| | | | | 1531 | Carboxylates |
| | | | | 872, 713 | Calcium carbonate |
| | | | | 1622, 778 | Calcium oxalate · $H_2O$ |
| | | | Raman | 143, 287 | Litharge/Massicot/Naples yellow |
| | | | | 1319, 1586 | Carbon black |
| | | | | 71, 102, 1048, 1052 | Lead white |
| | | | | 979 | Anglesite $PbSO_4$ |
| | | | | 154, 1080 | Calcite |
| LM-40076 | Giambattista Somazzi By anonymous | 1733 | XRF | Pb, Fe, Mn, Ca | Lead white, calcium carbonate, earth pigment |
| | | | FTIR | 3696, 3653, 3620, 1087, 1030, 1006, 940, 912, 795, 735 | Kaolinite |
| | | | | 3536, 1396, 837, 678 | Lead white (basic) |
| | | | | 2921, 2851, 1710, 1166, | Drying oil |
| | | | | 1514 | Lead stearate |
| | | | | 1396, 873, 711 | Calcium carbonate |
| | | | | 1615, 1314, 778 | Calcium oxalate · $H_2O$ |
| | | | Raman | 226, 244, 291, 410, 495, 613, 1314 | Heamatite |
| | | | | 1050 | Lead white |

| | | | | | |
|---|---|---|---|---|---|
| | | | | 1315, 1562 | Carbon black |
| LM-7723 | Salomon Ruppert<br>By Caspar Bachmann | 1797 | XRF | Pb, Ca, Fe | Lead white, calcium carbonate, earth pigment |
| | | | FTIR | 3696, 3654, 3619, 1115, 1084, 1030, 1006, 939, 912, 796, 752 | Kaolinite |
| | | | | 3536, 1399, 837, 677 | Lead white (basic) |
| | | | | 2920, 2850, 1710, 1169 | Drying oil |
| | | | | 1518 | Lead stearate |
| | | | | 1399, 873, 711 | Calcium carbonate |
| | | | | 1616, 1314, 778 | Calcium oxalate · $H_2O$ |
| | | | Raman | 225, 244, 293, 410, 495, 610 | Heamatite |
| | | | | 1306, 1590 | Carbon black |
| | | | | 150, 1080 | Calcite |
| LM-52427 | Marie Regine Krus-Guérmand<br>By Johann Melchior Joseph Wyrsch | 1783 | XRF | Pb, Fe, Ca | Lead white, calcium carbonate, earth pigment |
| | | | FTIR | 3698, 3650, 3619, 1096, 1030, 1006, 941, 912, 798, | Kaolinite |
| | | | | 3532, 1399, 839, 678 | Lead white (basic) |
| | | | | 2924, 2853, 1702, 1162 | Drying oil |
| | | | | 1514 | Lead stearate |
| | | | | 1399, 874, 711 | Calcium carbonate |
| | | | | 1620, 1316, 778 | Calcium oxalate · $H_2O$ |
| | | | Raman | 463 | Quartz |
| | | | | 1098 | Dolomite |
| | | | | 225, 248, 293, 411, 611, 1312 | Heamatite |
| | | | | 57, 73, 102, 151, 1056 | PbCO3 |
| SIK-98511 a) | Bildnis Margrit mit roter Jacke und Konzertkleid by Franz Rederer | 1962 | XRF | Zn, Pb, Ti, (Cr, Ca, Mn, Fe, Co, Cu) | ZnO, $TiO_2$, $PbCO_3$ |
| | | | FTIR | 2925, 2853, 1741, 1458, 1162 | Linseed oil |
| | | | | 3542, 1405, 1043, 839, 681 | Lead white (basic) |
| | | | Raman | 141s | $TiO_2$-anatase |
| | | | | 587, 547s, 374 | Ultramarine |

| | | | | | |
|---|---|---|---|---|---|
| | | | | 1542s, 1341, 1218, 775, 741, 686 | PG7 (traces) |

a) Data already published in Hendriks et al. (2018)[9]

*Table S-2 Summary of the material characterisation results conducted on the target margins from British paintings.*

| Artist | Signed date | Method | Laboratory data | Interpretation |
|---|---|---|---|---|
| Marco Ricci | 1711 | FTIR | 3535, 1392, 1045, 833, 680 | Lead white |
| | | | 2923, 2852, 1707, 777 | Drying oil |
| | | | 1517 | Lead stearate |
| | | | 1392, 1095, 871, 711 | Calcium carbonate |
| | | | 722 | Dolomite |
| | | Raman | 57, 72, 100, 1053 | Lead white |
| | | | 153, 283, 711, 1086 | Calcite |
| | | | 288, 402 | Heamatite |
| PH Hill | 1795 | FTIR | 2923, 2852, 1707, 1629, 1176, 780 | Drying oil |
| | | | 2513, 1798, 1392, 1087, 871, 712 | Calcium carbonate |
| | | | 1046, 830, 681 | Lead white |
| | | | 1629 | Lead oxalate |
| | | Raman | 1310, 1595 | Carbon black |
| | | | 85, 103, 252, 287, 343 | Vermillion |
| | | | 88, 203, 245, 299, 390, 554 | Goethite |
| Joshua Reynolds | 1765 | FTIR | 3537, 1392, 1045, 837, 680 | Lead white |
| | | | 2922, 2851, 1733, 1702, 1167, 1097, 773 | Drying oil |
| | | | 1508 | Lead stearate |
| | | | 2514, 1796, 1392,872, 712 | Calcium carbonate |
| | | | 3290, 1633, 1530, 1403 | Proteinous material |
| | | | 1152, 1104, 1080, 1032 | Silicates |
| | | Raman | 1310,1585 | Carbon black |
| | | | 82,138 | Massicot/Litharge/Naples yellow |

| | | | | |
|---|---|---|---|---|
| | | | 88, 103, 254, 283, 342 | Vermillion |
| Richard wilson | 1761 | FTIR | 3535, 1391, 1045, 839, 679 | Lead white |
| | | | 2924, 2852, 1707, 1170, 1108 | Drying oil |
| | | | 2514, 1796, 1391, 871, 712 | Calcium carbonate |
| | | | 1618, 777 | Calcium oxalate · $H_2O$ |
| | | Raman | 1313, 1592 | Carbon black |
| | | | 252, 343 | Vermillion |
| Georges Romney (a) | 1770 | FTIR | 3539, 1388, 1051, 837, 678 | Lead white |
| | | | 2921, 2851, 1732, 1703, 1163 | Drying oil |
| | | | 2515, 1796, 1388, 1097, 871, 712 | Calcium carbonate |
| | | | 1622, 777 | Calcium oxalate · $H_2O$ |
| | | Raman | 71, 85, 143, 284 | Massicot |
| | | | 222, 238, 287, 403, 491, 605, 1306 | Haematite |
| | | | 1316, 1585 | Carbon black |
| Georges Romney (b) | 1770 | FTIR | 3539, 1388, 1051, 837, 678 | Lead white |
| | | | 2921, 2851, 1732, 1703, 1163 | Drying oil |
| | | | 2515, 1796, 1388, 1097, 871, 712 | Calcium carbonate |
| | | | 1622, 777 | Calcium oxalate · $H_2O$ |
| | | Raman | 1310, 1580 | Carbon black |
| | | | 71, 85, 142, 281 | Massicot |
| Samuel Alken | 1795 | FTIR | 3532, 1389, 1046, 681 | Lead white |
| | | | 2927, 2851, 1705, 1160, 1108 | Drying oil |
| | | | 2514, 1796 1389, 1087, 871, 712 | Calcium carbonate |
| | | Raman | 732, 750, 1334, 1545 | Phthalocyanine |
| | | | 154, 282, 1085 | Calcite |
| | | | 140, 278 | Massicot/Litharge/Naples yellow |
| | | | 1313, 1585 | Carbon black |
| | | | 226, 245, 293, 411, 496, 613, | Heamatite |
| JF | 1803 | FTIR | 3532, 1390, 1045, 680 | Lead white |

| | | | | |
|---|---|---|---|---|
| Sartorius | | | 2922, 2852, 1707, 1159, 1060 | Drying oil |
| | | | 2514, 1796, 1390, 872, 712 | Calcium carbonate |
| | | | 1615, 776 | Calcium oxalate · $H_2O$ |
| | | | 1517 | Lead stearate |
| | | Raman | 1310, 1585 | Carbon black |
| | | | 82, 138 | Massicot/Litharge/Naples yellow |
| | | | 108, 1051 | Lead white |
| | | | 154, 1080 | Calcite |
| JW Swift | 1840 | FTIR | 3533, 1391, 1045, 838, 680 | Lead white |
| | | | 2926, 2853, 1729, 1174 | Calcium carbonate |
| | | | 2516, 1798, 1391, 1085,871, 712 | Calcium carbonate |
| | | | 1525 | Lead stearate |
| | | | 1620, 776 | Calcium oxalate · $H_2O$ |
| | | Raman | 1315, 1585 | Carbon black |
| | | | 153, 1088 | Calcite |
| | | | 223, 290, 407 | Heamatite |
| | | | 76, 106, 1054 | Lead white |
| | | | 622, 1002 | Gypsum |
| William Meadows | 1868 | FTIR | 3535, 1384, 1045, 837, 678 | Lead white |
| | | | 2921, 2851, 1729, 1176 | Drying oil |
| | | | 2513, 1796, 1384, 1089, 872, 712 | Calcium carbonate |
| | | | 1510 | Lead stearate |
| | | | (1620), 776 | Calcium oxalate · $H_2O$ |
| | | Raman | 1315, 1585 | Carbon black |
| | | | 82, 112, 151, 276, 2095, 2122, 2157 | Prussian blue |
| | | | 76, 222, 287, 404, 493, 605 | Heamatite |
| | | | 1013 | Anhydrite |
| | | | 85, 104, 254, 286, 343 | Vermillion |
| | | | 72, 105, 1051 | Lead white |

| | | | | |
|---|---|---|---|---|
| Henry Tanworth Wells | 1874 | FTIR | 3535, 1392, 1045, 837, 680 | Lead white |
| | | | 2920, 2852, 1733, 1711, 1176 | Drying oil |
| | | | 2518, 1796, 1392, 872, 712 | Calcium carbonate |
| | | | 1509 | Lead stearate |
| | | | 1620, 775 | Calcium oxalate · $H_2O$ |
| | | Raman | 1313, 1590 | Carbon black |
| | | | 75, 106, 1052 | Lead white |
| | | | 225, 244, 292, 409, 496, 609 | Heamatite |
| | | | 91, 244, 300, 393, 478, 549, 1378 | Goethite |
| Sir Arthur Stockdale Cope | 1901 | FTIR | 3357, 1393, 1045, 680 | Lead white |
| | | | 2920, 2851, 1738, 1703, 1166, 1101 | Drying oil |
| | | | 1514 | Lead stearate |
| | | | 928, 852 | Earth pigment |
| | | | (1620), 769 | Calcium oxalate · $H_2O$ |
| | | Raman | 239, 485, 844, 904, 1164, 1190, 1222, 1293, 1331, 1359, 1484, 1520 | Alizarin krapplack PR83 |
| | | | 69, 86, 142, 282 | Massicot |
| | | | 536, 827 | Lazurite/ultramarine |
| | | | 110, 156, 673, 1053 | Lead white |
| | | | 672, 535 | Cerulean blue |
| | | | 1319, 1576 | Carbon black |
| | | | 220, 293, 407, 1310 | Heamatite |

*Table S-3 Overview of the radiocarbon data collected on the samples from the Swiss paintings provided by the Swiss National Museum (CH) as well as Margrit's portrait by Franz Rederer from the SIK-ISEA collection (CH). The results are summarized as sample code, title of object and respective artist, signed date, ETH laboratory code, targeted material (lead carbonate, organic binder of the paint, canvas textile), the measured $^{14}C$ ages with 1σ uncertainty and corresponding fraction modern $F^{14}C$, the measured amount of carbon and the respective calibrated calendar ages using the calibration software Oxcal v.4.3.2 [10,11] with Intcal13 calibration curve [12] and post-bomb atmospheric NH1 curve[13].*

| Code | Title/object - artist | Date | ETH Nr. | Targeted Material | $^{14}C$ Age [yr BP] | σ | $F^{14}C$ | σ | C mass [µg] | Calibrated age interval (95.4% confidence interval) |
|---|---|---|---|---|---|---|---|---|---|---|
| LM-161897 | Eric Magnus Louis Grand Hauteville By anonymous in style of Amélie Munier Romilly | 1813 | 96797.1.1 | carbonate | 227 | 63 | 0.972 | 0.008 | 63 | Mean value: 251 +- 45<br>1493-1602 & 1615-1684 & 1734-1807 & 1930 - 1954 |
| | | | 96797.2.1 | carbonate | 274 | 63 | 0.966 | 0.008 | 75 | |
| | | | 96798.1.1 | paint | 206 | 54 | 0.975 | 0.007 | 144 | Mean value: 257 +- 41<br>1493-1602 & 1615-1682 & 1738-1754 &1762-1803 & 1937-1950 |
| | | | 96798.2.1 | paint | 322 | 62 | 0.961 | 0.007 | 279 | |
| | | | 96799.1.1 | textile | 151 | 20 | 0.981 | 0.002 | 990 | 1667-1698 & 1724-1783 & 1796-1816 & 1834-1879 & 1916-1954 |
| LM-114651 | Adolphe Morand By Jh. Loretti | 1863 | 96800.1.1 | carbonate | -71 | 151 | 1.009 | 0.019 | 11 | 1637-1956 |
| | | | 96801.1.1 | paint | -149 | 96 | 1.019 | 0.012 | 15 | 1680-1764 & 1801-1957 |
| LM-158151 | Hugo Siegwart By Carl August Liner | 1907 | 96802.1.1 | carbonate | 312 | 70 | 0.962 | 0.008 | 29 | 1440-1680 & 1764-1801 & 1939-1950 |
| | | | 96803.1.1 | paint | 247 | 129 | 0.970 | 0.016 | 14 | 1451-1894 & 1905-1950 |
| LM-161803 | Preliminary design for "Die Wiege der Eidgenossenschaft" By Charles Giron | 1899 - 1902 | 96804.1.1 | carbonate | 226 | 326 | 0.972 | 0.039 | 9 | 1183-1950 |
| LM-40076 | Giambattista Somazzi By anonymous | 1733 | 96806.1.1 | carbonate | 261 | 80 | 0.968 | 0.010 | 25 | 1449-1699 & 1721-1818 & 1833-1879 & 1916-1950 |
| | | | 96807.1.1 | paint* | 316 | 55 | 0.961 | 0.007 | 107 | N/A |
| LM-7723 | Salomon Ruppert By Caspar Bachmann | 1797 | 96808.1.2 | carbonate | 132 | 64 | 0.984 | 0.008 | 55 | 1665-1785 & 1793-1950 |
| | | | 96809.1.1 | paint* | 291 | 55 | 0.964 | 0.007 | 1201 | N/A |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| LM-52427 | Marie Regine Krus-Guérmand By Johann Melchior Joseph Wyrsch | 1783 | 96810.1.1 | carbonate | 154 | 76 | 0.981 | 0.009 | 25 | 1642-1954 |
| | | | 96811.1.1 | paint | 266 | 55 | 0.967 | 0.007 | 84 | 1469-1684 & 1735-1806 & 1931-1950 |
| SIK-98511 | Bildnis Margrit mit roter Jacke und Konzertkleid by Franz Rederer | 1962 | 57442.2.1 | Canvas [a)] | -888 | 25 | 1.117 | 0.004 | 997 | 1957-1958 & 1993-1997 |
| | | | 69024.1.1 | paint [a)] | -183 | 30 | 1.023 | 0.004 | 398 | 1955-1956 |
| | | | 69024.4.1 | carbonate [b)] | 25724 | 223 | 0.041 | 0.005 | 93 | Industrial process, > 19th century |
| | | | 69024.9.1 | carbonate | 5261 | 93 | 0.519 | 0.006 | 67 | Industrial process, > 19th century |
| | | | 88907.3.1 | carbonate | 5713 | 94 | 0.491 | 0.006 | 66 | Industrial process, > 19th century |

[a)] Data published in Hendriks et al. (2018)[9]

[b)] Data published in (Hendriks et al., 2019)[14]

* not calibrated, as $^{14}C$ age is biased due to presence of carbon black.

*Table S-4 Overview of the radiocarbon data collected on the samples from the British paintings clippings provided by the Harvard museum (USA). The results are summarized as artist, signed date, ETH laboratory code, targeted material (lead carbonate, organic binder of the paint, canvas textile), the measured $^{14}C$ ages with 1sigma uncertainty and corresponding fraction modern $F^{14}C$, the measured amount of carbon and the respective calibrated calendar ages using the calibration software Oxcal v.4.3.2[10,11] with Intcal13 calibration curve[12] and post-bomb atmospheric NH1 curve[13].*

| Artist | Date | ETH Nr. | Targeted Material | $^{14}C$ Age [yr BP] | σ | $F^{14}C$ | σ | C mass [µg] | Calibrated age interval (95.4% confidence interval) |
|---|---|---|---|---|---|---|---|---|---|
| Marco Ricci | 1711 | 95049.1.2 | carbonate | -9 | 54 | 1.001 | 0.007 | 42 | 1688-1730 & 1809-1927 & 1954-1956 |
| | | 95050.1.1 | paint | 177 | 59 | 0.978 | 0.007 | 420 | Mean: 203 +-43<br>1637-1706 & 1719-1820 & 1832 -1882 & 1914-1950 |
| | | 95050.2.1 | paint | 232 | 61 | 0.971 | 0.007 | 249 | |
| | | 95051.1.1 | textile | 96 | 20 | 0.988 | 0.002 | 988 | 1691-1729 & 1810-1923 |
| PH Hill | 1795 | 95052.1.1 | carbonate | 12 | 69 | 0.998 | 0.008 | 31 | 1680-1764 &1801-1939 & 1954-1956 |
| | | 95053.1.1 | paint* | 389 | 71 | 0.952 | 0.008 | 56 | N/A |
| | | 95054.1.1 | textile | 164 | 20 | 0.980 | 0.002 | 994 | 1666-1695 &1726-1785 & 1795-1814 & 1838-1843 & 1852-1868 & 1917-1950 |
| Joshua Reynolds | 1765 | 95055.1.1 | carbonate | -78 | 55 | 1.010 | 0.007 | 37 | 1693-1728 & 1812-1920 & 1954-1957 |
| | | 95056.1.1 | paint* | 435 | 64 | 0.947 | 0.007 | 69 | N/A |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 95056.2.1 | paint* | 421 | 55 | 0.949 | 0.006 | 182 | N/A |
| | | 95057.1.1 | textile | 193 | 20 | 0.976 | 0.002 | 997 | 1660-1681 & 1735-1806 & 1932-1950 |
| Richard Wilson | 1761 | 95061.1.1 | carbonate | -30 | 53 | 1.004 | 0.007 | 35 | 1691-1730 & 1810-1925 & 1954-1957 |
| | | 95062.1.1 | paint* | 477 | 74 | 0.942 | 0.009 | 68 | N/A |
| | | 95063.1.1 | textile | 221 | 21 | 0.973 | 0.003 | 981 | 1645-1680 & 1764-1801 & 1939 |
| Georges Romney | 1770 | 95064.1.1 | carbonate | 13 | 53 | 0.998 | 0.007 | 33 | Mean: 2 +- 36<br>1695-1727 & 1812-1854 & 1867-1919 & 1954-1957 |
| | | 95064.2.1 | carbonate | 36 | 76 | 0.996 | 0.009 | 33 | |
| | | 95064.3.1 | carbonate | -35 | 61 | 1.004 | 0.008 | 45 | |
| | | 95065.1.1 | paint* | 413 | 65 | 0.949 | 0.008 | 111 | N/A |
| | | 95066.1.1 | textile | 168 | 20 | 0.979 | 0.002 | 984 | 1665-1694 & 1726-1785 & 1793-1814 & 1918-1950 |
| Georges Romney | 1770 | 95067.1.1 | carbonate | 86 | 55 | 0.989 | 0.007 | 43 | 1677-1777 & 1800-1941 |
| | | 95068.1.1 | paint* | 523 | 59 | 0.937 | 0.007 | 347 | N/A |
| | | 95069.1.1 | textile | 158 | 20 | 0.980 | 0.002 | 997 | 1666-1697 & 1725-1784 & 1796-1815 & 1836-1877 & 1916-1950 |
| Samuel Alken | 1795 | 95070.1.1 | carbonate | 4247 | 79 | 0.589 | 0.006 | 24 | N/A |
| | | 95070.2.1 | carbonate | 4448 | 177 | 0.575 | 0.013 | 17 | N/A |
| | | 95071.1.1 | paint | 256 | 72 | 0.969 | 0.009 | 81 | 1692-1729 & 1811-1920 |
| | | 95071.2.1 | paint | 126 | 77 | 0.985 | 0.009 | 21 | 1663-1950 |
| | | 95072.1.1 | textile | 92 | 20 | 0.989 | 0.002 | 982 | 1692-1729 & 1811-1920 |
| JF Sartorius | 1803 | 95073.2.1 | carbonate | -78 | 82 | 1.010 | 0.010 | 22 | 1681-1739 & 1745-1763 & 1802-1938 & 1954-1957 |
| | | 95074.1.1 | paint* | 390 | 66 | 0.953 | 0.008 | 173 | N/A |
| | | 95074.3.1 | paint* | 278 | 55 | 0.966 | 0.007 | 186 | N/A |
| | | 95075.1.1 | textile | 201 | 20 | 0.975 | 0.002 | 979 | 1652-1684 & 1736-1805 & 1935-1950 |
| JW Swift | 1840 | 95076.1.1 | carbonate | 64 | 52 | 0.992 | 0.006 | 37 | 1680-1764 & 1801-1939 & 1954-1955 |
| | | 95077.1.1 | paint* | 362 | 67 | 0.956 | 0.008 | 85 | N/A |
| | | 95078.1.1 | textile | 99 | 20 | 0.988 | 0.002 | 983 | 1691-1730 & 1810-1925 |
| William Meadows | 1868 | 95079.2.1 | carbonate | 121 | 57 | 0.985 | 0.007 | 36 | 1669-1781 & 1798-1945 & 1954-1955 |
| | | 95080.2.1 | paint* | 480 | 58 | 0.942 | 0.007 | 47 | N/A |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 95081.1.1 | textile | 91 | 20 | 0.989 | 0.002 | 995 | 1692-1729 & 1811-1920 |
| Henry Tanworth Wells | 1874 | 95082.1.1 | carbonate | 178 | 65 | 0.978 | 0.008 | 21 | Mean: 169 +- 60<br>1649-1894 & 1905-1950 |
| | | 95082.2.1 | carbonate | 120 | 148 | 0.985 | 0.018 | 10 | |
| | | 95083.1.1 | paint* | 566 | 67 | 0.932 | 0.008 | 89 | N/A |
| | | 95083.2.1 | paint* | 362 | 57 | 0.955 | 0.006 | 39 | N/A |
| | | 95084.1.1 | textile | 102 | 20 | 0.987 | 0.002 | 998 | 1690-1730 & 1810-1926 |
| Sir Arthur Stockdale Cope | 1901 | 95085.1.1 | carbonate | -100 | 50 | 1.012 | 0.006 | 61 | Mean: -40 +- 35<br>1697-1724 & 1814-1835 & 1877-1918 & 1954-1957 |
| | | 95085.3.1 | carbonate | 68 | 60 | 0.992 | 0.007 | 33 | |
| | | 95085.4.1 | carbonate | -88 | 83 | 1.011 | 0.010 | 32 | |
| | | 95086.1.1 | paint* | 338 | 64 | 0.959 | 0.008 | 411 | N/A |
| | | 95086.2.1 | paint* | 320 | 63 | 0.961 | 0.008 | 481 | N/A |
| | | 95086.4.1 | paint* | 231 | 53 | 0.971 | 0.006 | 297 | N/A |
| | | 95087.1.1 | textile | 103 | 20 | 0.987 | 0.002 | 986 | 1689-1730 & 1809-1926 |

* not calibrated, as $^{14}C$ age is biased due to presence of carbon black.

*Table S-5: Digestion parameter for the following ICPMS-measurements: The provided sample were digested upon addition of 2 ml water (milli-Q) and 2 ml nitric acid (sub-boiled, in-house), which was carried out over 30 minutes in a turboWAVE microwave assisted digestion system (MLS GmbH, Leutenkirch, Germany) at 220 °C and 40 bar*

| Instrumentation | turboWAVE microwave assisted digestion system (MLS GmbH, Leutenkirch, Germany) |
|---|---|
| Parameter | |
| Media | 2 ml Water (milli-Q), 2 ml Nitric acid (sub-boiled, in-house |
| Time | 30 min |
| Temperature | 220 °C |
| Pressure | 40 bar |
| Microwave assistance | 1200 W |

*Table S-6: Technical parameter for the quantification by Q-ICPMS (Agilent7500, Agilent Technologies, Santa Clara, USA).*

| Parameter: | ICPMS |
|---|---|
| RF power | 1450 W |
| Plasma gas flow | 15.2 l/min |
| Carrier gas | 0.91 l/min |
| Make-up gas | 0.1 l/min |
| Nebulizer gas | 0.1 l/min |
| Cone material | Ni |
| Dwell time | 50 ms |
| Measured isotopes | $^{202}Hg$, $^{203}Tl$, $^{204}Pb$, $^{205}Tl$, $^{206}Pb$, $^{207}Pb$, $^{208}Pb$, $^{209}Bi$ |
| Internal standard | $^{205}Tl$ |
| Calibration approach | External Calibration |

*Table S-7: Operating conditions for the Nu plasma HR MC-ICPMS*

| | | | |
|---|---|---|---|
| RF-power | 1350 W | | |
| Plasma gas flow | 13.0 L $min^{-1}$ Ar | | |
| Auxiliary gas flow | 0.9 L $min^{-1}$ Ar | | |
| Nebulizer gas pressure | 33.0 PSI | | |
| Cone material | Ni | | |
| Blocks | 5 | | |
| Measurements | 10 | | |
| Integration time | 5 s | | |
| Assignment to Faraday cup detector* | (Hg) | (200) | (L3) |
| | Hg | 202 | L2 |
| | Tl | 203 | L1 |
| | Pb | 204 | Ax |
| | Tl | 205 | H1 |
| | Pb | 206 | H2 |
| | Pb | 207 | H3 |
| | Pb | 208 | H4 |
| Nebulizer type | Meinhard type | | |
| Sample uptake | 80 uL $min^{-1}$ | | |

**Data processing**: The data were corrected for instrumental background using ESA deflection and for isobaric overlap of $^{204}Hg$ via the measurement of $^{202}Hg$ (http://hbcponline.com, 08.2019). Measured isotope ratios that were out of the range of the mean plus or minus two times the standard deviation were considered as outliers and discarded. Mass discrimination correction was performed against the previously calibrated thallium standard using the exponential model[15] and periodically verified against SRM NIST981 (NIST, USA) published values[16,17].

The thallium correction was performed based on frequent measurements of NIST SRM981 (400 ppb) with the addition of thallium (200 ppb), either a liquid standard (Inorganic ventures, D2-TL01114) or NIST SRM991, in minimum prior and after every measurement set. The two different sources of Tl-standard solutions showed negligible differences in the resulting Tl-ratio. The Tl isotope-ratio was calculated from Pb isotope analyses of SRM 981 after mass correction for mass discrimination using the exponential model.[15] The $^{207}Pb/^{206}Pb$ isotope ratio given by the NIST SRM981 was used as a basis to calculate the adjusted Tl-ratio for all the measurements. In table S-8 the average $^{205}Tl/^{203}Tl$-ratio from the long-term stability of the measurements (41 samples) and with just the samples containing SRM991 (14 samples) are given.

*Table S-8: Long-term stability of the thallium ratio determined from SRM981 measurements given as a means with standard deviation, standard error and the confidence intervals. The numbers are given calculated with the lead isotope ration from the $^{207}Pb/^{206}Pb$ and the $^{208}Pb/^{206}Pb$ data. The long-term stability includes 41 measurements including 14 samples with SRM991 and 27 measurements with a liquid Tl-standard solution.*

| | Mean | SD | SE | CI (0.95) |
|---|---|---|---|---|
| **$^{207}Pb/^{206}Pb$** | | | | |
| $^{205}Tl/^{203}Tl$ – long term | 2.388583 | $3.8\cdot10^{-4}$ | $8\cdot10^{-6}$ | Upper 2.388603<br>Lower 2.388570 |
| $^{205}Tl/^{203}Tl$ – SRM991 | 2.388445 | $3.9\cdot10^{-4}$ | $1.5\cdot10^{-5}$ | Upper 2.388475<br>Lower 2.388415 |
| **$^{208}Pb/^{206}Pb$** | | | | |
| $^{205}Tl/^{203}Tl$ – long term | 2.388641 | $3.6\cdot10^{-4}$ | $8.2\cdot10^{-6}$ | Upper 2.388657<br>Lower 2.388624 |
| $^{205}Tl/^{203}Tl$ – SRM991 | 2.388554 | $5.5\cdot10^{-4}$ | $2.18\cdot10^{-5}$ | Upper 2.388597<br>Lower 2.388511 |

## Stability over Time

The overall stability during the measurement session was controlled by frequent standard measurements and is listed in Table S-9. Given with the correspondent literature values. One has to be aware the mass bias correction is based on the empirical determined Thallium ratio which is based on these standard measurements and contains therefore a circular logic.

*Table S-9: Mean values of lead isotope abundance ratios for SRM 981 (NIST, USA) measured during all measurement sets*

| | Mean | RSD % | Literature values[16] |
|---|---|---|---|
| $^{208}Pb/^{206}Pb$ | 2.16774(16) | 0.007 | 2.16701 |
| $^{207}Pb/^{206}Pb$ | 0.914813(34) | 0.004 | 0.91464 |
| $^{208}Pb/^{204}Pb$ | 36.7106(75) | 0.02 | |

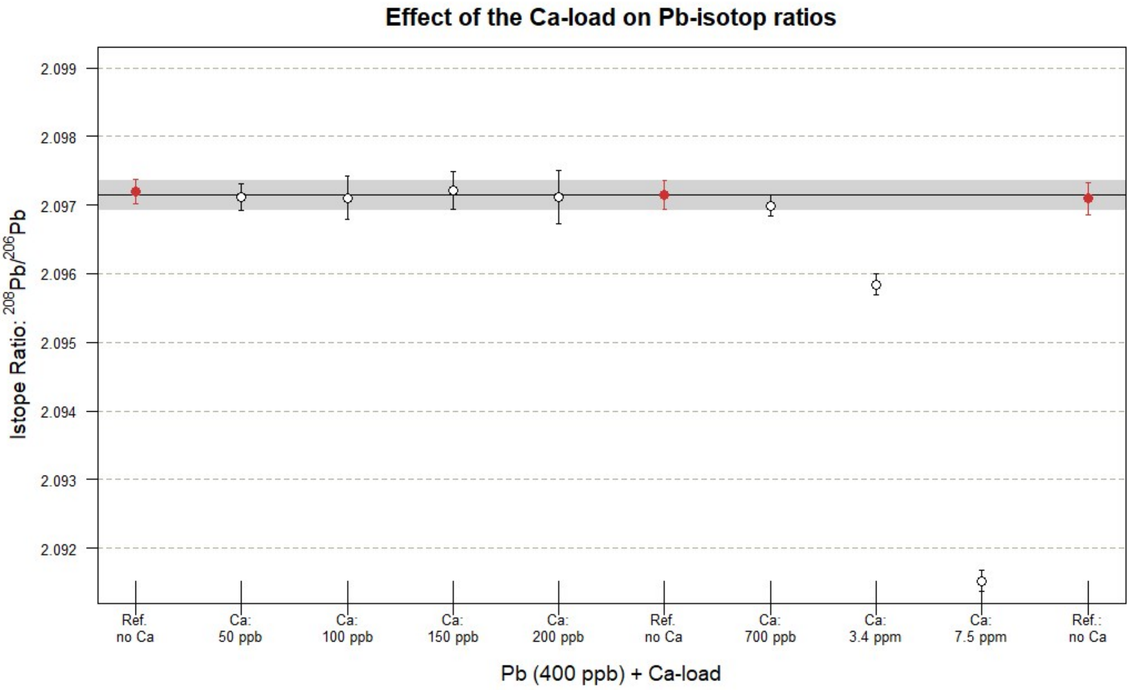



*Figure S-4: Influence of additional Ca (white points, in form of added $CaCO_3$ prior to the digestion: 50, 100, 150, 200, 700, 3'400 and 7'500 ppb, Kremer Pigmente GmbH & Co, Aichstetten/Allgau, Germany) in Pb-Samples (400 ppb, #46000, Kremer Pigmente GmbH & Co, Aichstet-ten/Allgau, Germany ) in regards to the determined Pb-isotope ratios (shown $^{208}Pb/^{206}Pb$) given with the standard deviation. The black line (2.097143 +/- SD (grey area)) is the average from the control measurements, "Ref. no Ca" (red). A Ca-load of >700 ppb rel. to 400 ppb Pb results in high deviation to the true value by keeping a low SD.*

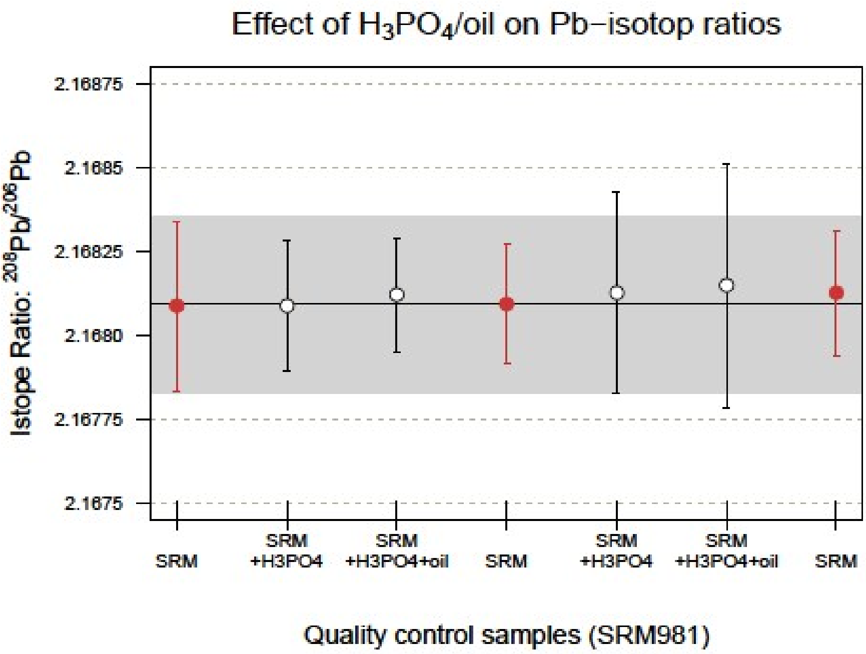



*Figure S-5: Effect of the addition of up to 1% $H_3PO_4$ (+ acid) and linseed oil (+ oil) (white points, #73504, Kremer Pigmente GmbH & Co, Aichstetten/Allgau, Germany) to a Pb-Solution (400 ppb, NIST SRM981) in regards to the isotope ratios after digestion and dilution. The pure Pb-solution is given in red with the individual SD and the mean of the three measurement (black line) with SD (grey box).*

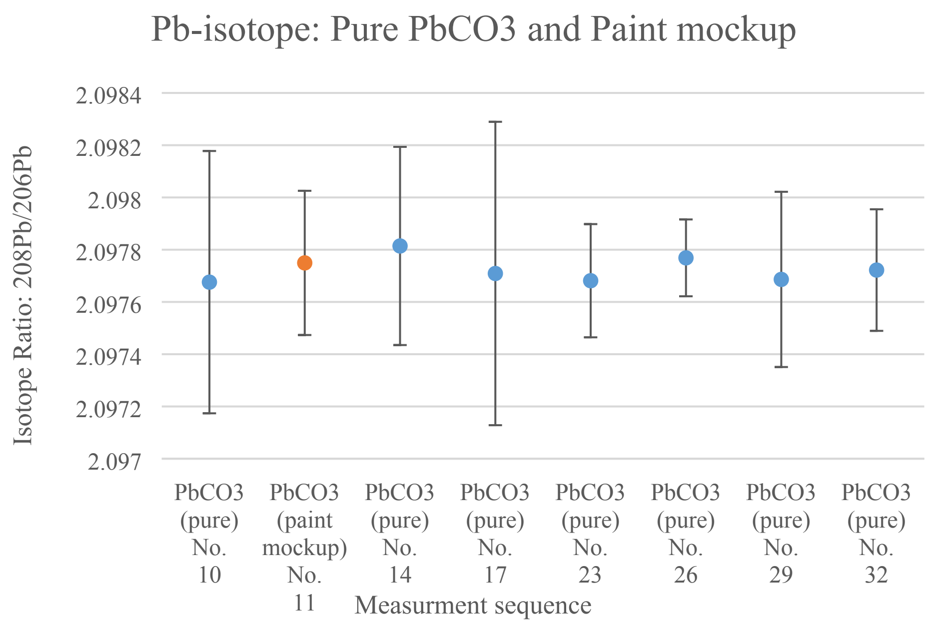



*Figure S-6 Effect on the Pb-isotope ration under the addition of linseed oil (#73504, Kremer Pigmente GmbH & Co, Aichstetten/Allgau, Germany) to pure $PbCO_3$ ( #73504, Kremer Pigmente GmbH & Co, Aichstetten/Allgau, Germany) to reconstruct a lead white oil paint. The samples were digested and further diluted to a Pb-Solution (400 ppb) with the addition of 200 ppb Tl. The results for the pure Pb-solution (only $PbCO_3$) is given in blue over a measurement series indicated by the measurement number (No.) with the individual SD. The paint mockup is given in orange with the SD (No. 11).*

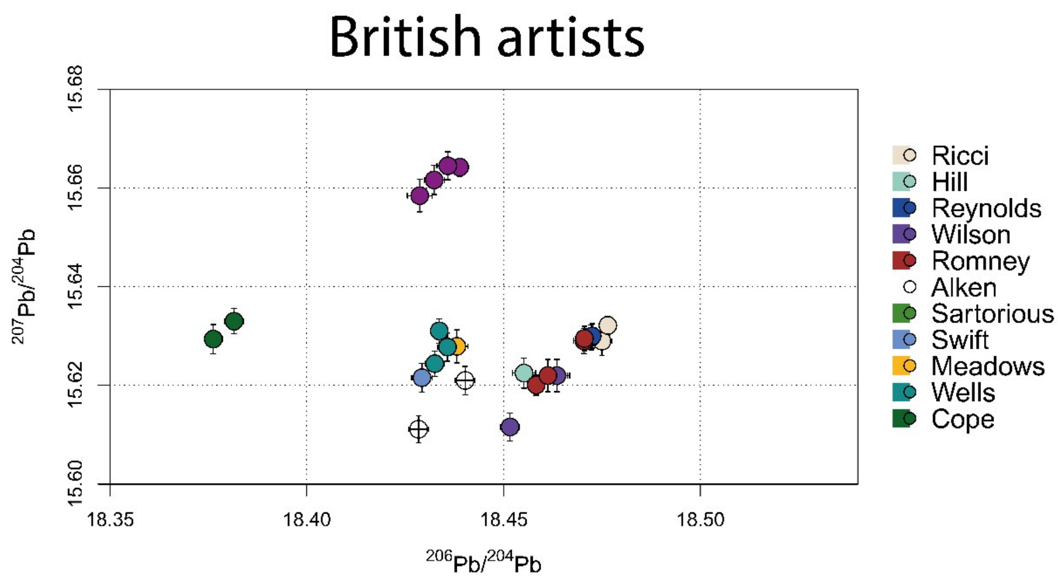
*Table S-10 Overview of the lead isotope ratios for all the investigated samples, namely $^{208}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, $^{206}Pb/^{204}Pb$, $^{208}Pb/^{206}Pb$ and $^{207}Pb/^{206}Pb$ with the corresponding RSD (1s, in %). They are summarized as artist, signed date, ETH laboratory code, the lead isotope ratios, the delta value Δ (in %) to the corresponding not Hg-corrected ratios and additional comments if necessary. *A high load of $CaCO_3$ in the samples (>64%) has an influence on the true lead isotope ratios and the data has therefore to be discarded.*

| **Artist** | **Signed date** | **ETH No.** | **$^{208}Pb/^{204}Pb$** | | **$^{207}Pb/^{204}Pb$** | | **$^{206}Pb/^{204}Pb$** | | **Delta to the not Hg-corrected value (Δ)** | **Comments / Explanation** |
|---|---|---|---|---|---|---|---|---|---|---|
| Marco Ricci | 1711 | 95049.1.1 | 38.4226 | 0.017% | 15.6291 | 0.016% | 18.4752 | 0.016% | 0.06% | |
| | | 95049.2.1 | 38.4296 | 0.015% | 15.6323 | 0.011% | 18.4767 | 0.010% | 0.11% | |
| PH Hill | 1795 | 95052.1.1 | 38.4360 | 0.018% | 15.6226 | 0.019% | 18.4553 | 0.017% | 0.06% | |
| Joshua Reynolds | 1765 | 95055.1.1 | 38.4302 | 0.016% | 15.6300 | 0.016% | 18.4726 | 0.014% | 0.13% | |
| | | 95055.2.1 | 38.4327 | 0.015% | 15.6302 | 0.014% | 18.4727 | 0.013% | 0.11% | |
| Richard wilson | 1761 | 95061.1.1 | 38.4411 | 0.015% | 15.6116 | 0.016% | 18.4517 | 0.015% | 0.01% | |
| | | 95061.2.1 | 38.4667 | 0.019% | 15.6220 | 0.018% | 18.4636 | 0.018% | 0.02% | |
| Georges Romney (a) / (b) | 1770 | 95064.1.1 | 38.4061 | 0.020% | 15.6202 | 0.014% | 18.4584 | 0.011% | 0.07% | |
| | | 95067.1.1 | 38.4060 | 0.029% | 15.6220 | 0.035% | 18.4613 | 0.018% | 0.01% | |
| | | 95064.3.1 | 38.4309 | 0.026% | 15.6290 | 0.017% | 18.4704 | 0.014% | 0.02% | |
| | | 95067.2.1 | 38.4275 | 0.015% | 15.6295 | 0.015% | 18.4706 | 0.013% | 0.01% | |
| Samuel Alken | 1795 | 95070.1.1 | ~~38.4157~~ | ~~0.017%~~ | ~~15.6111~~ | ~~0.016%~~ | ~~18.4284~~ | ~~0.015%~~ | ~~0.01%~~ | *Ca-load too high |
| | | 95070.2.1 | ~~38.4422~~ | ~~0.018%~~ | ~~15.6210~~ | ~~0.016%~~ | ~~18.4403~~ | ~~0.015%~~ | ~~0.01%~~ | *Ca-load too high |
| JF Sartorius | 1803 | 95073.1.1 | NA | NA | NA | NA | NA | NA | NA | |
| | | 95073.3.1 | 38.4283 | 0.019% | 15.6216 | 0.017% | 18.4293 | 0.016% | 0.01% | |
| JW Swift | 1840 | 95076.1.1 | 38.4390 | 0.021% | 15.6279 | 0.018% | 18.4382 | 0.018% | 0.01% | |
| William Meadows | 1868 | 95079.1.1 | 38.4288 | 0.017% | 15.6245 | 0.015% | 18.4326 | 0.014% | 0.03% | |
| | | 95079.1.1 | 38.4449 | 0.018% | 15.6278 | 0.016% | 18.4358 | 0.015% | 0.00% | |
| | | 95079.2.1 | 38.4552 | 0.014% | 15.6310 | 0.014% | 18.4337 | 0.013% | 0.01% | |
| Henry Tanworth Wells | 1874 | 95082.1.1 | 38.4117 | 0.021% | 15.6295 | 0.015% | 18.3764 | 0.016% | 0.04% | |
| | | 95082.2.1 | 38.4206 | 0.013% | 15.6330 | 0.015% | 18.3816 | 0.014% | 0.01% | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Sir Arthur Stockdale Cope | 1901 | 95085.1.1 | 38.5513 | 0.012% | 15.6642 | 0.011% | 18.4389 | 0.010% | 0.01% | |
| | | 95085.3.1 | 38.5298 | 0.031% | 15.6585 | 0.020% | 18.4287 | 0.018% | 0.01% | |
| | | 95085.3.1 | 38.5379 | 0.019% | 15.6617 | 0.016% | 18.4324 | 0.016% | 0.03% | |
| | | 95085.5.1 | 38.5435 | 0.017% | 15.6645 | 0.017% | 18.4358 | 0.015% | 0.01% | |
| **Title/object - artist** | | | | | | | | | | |
| Eric Magnus Louis Grand Hauteville – By anonymous in style of Amélie Munier Romilly | 1813 | LM-161897 | 38.4395 | 0.019% | 15.6258 | 0.017% | 18.4418 | 0.015% | 0.01% | |
| | | LM-161897 | 38.4366 | 0.019% | 15.6252 | 0.017% | 18.4410 | 0.017% | 0.01% | |
| | | LM-161897 | 38.4311 | 0.029% | 15.6234 | 0.030% | 18.4393 | 0.028% | 0.01% | |
| Adolphe Morand – By Jh. Loretti | 1863 | LM-114651 | 38.3668 | 0.019% | 15.6253 | 0.019% | 18.3794 | 0.018% | 0.02% | |
| Hugo Siegwart – By Carl August Liner | 1907 | LM-158151 | ~~38.7349~~ | ~~0.019%~~ | ~~15.6618~~ | ~~0.019%~~ | ~~18.5291~~ | ~~0.017%~~ | ~~0.02%~~ | *Ca-load to high |
| Preliminary design for “die Wiege der Eidgenosssenschaft” – By Charles Giron | 1899-1902 | LM-161803 | NA | NA | NA | NA | NA | NA | NA | Sample amount not sufficient for analysis |
| Giambattista Somazzl – By anonymous | 1733 | LM-40076 | 38.4100 | 0.020% | 15.6308 | 0.020% | 18.4468 | 0.019% | 0.29% | |
| Salomon Ruppert – By Caspar Bachmann | 1797 | LM-7723 | 38.4181 | 0.028% | 15.6242 | 0.016% | 18.4341 | 0.014% | 0.40% | |
| Marie Regine Krus-Guérmand – By Joseph Wyrsch | 1783 | LM-52427 | 38.4288 | 0.016% | 15.6268 | 0.019% | 18.4422 | 0.017% | 0.11% | |
| Margrit – by Franz Rederer SIK-98511 | 1962 | 88907.3.1 | 38.5654 | 0.031% | 15.6525 | 0.031% | 18.4167 | 0.035% | 0.01% | |
| | | 69024.9.1 | 38.5662 | 0.035% | 15.6526 | 0.030% | 18.4152 | 0.029% | 0.02% | |
| **Artist** | **Signed date** | **ETH No.** | **$^{208}Pb/^{206}Pb$** | | **$^{207}Pb/^{206}Pb$** | | | | | **Comments / Explanation** |
| Marco Ricci | 1711 | 95049.1.1 | 2.07970 | 0.007% | 0.845971 | 0.004% | | | | |
| | | 95049.2.1 | 2.07989 | 0.007% | 0.846047 | 0.004% | | | | |
| PH Hill | 1795 | 95052.1.1 | 2.08266 | 0.006% | 0.846506 | 0.005% | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Joshua Reynolds | 1765 | 95055.1.1 | 2.08039 | 0.006% | 0.846115 | 0.004% | | | | |
| | | 95055.2.1 | 2.08051 | 0.007% | 0.846122 | 0.004% | | | | |
| Richard wilson | 1761 | 95061.1.1 | 2.08331 | 0.005% | 0.846083 | 0.004% | | | | |
| | | 95061.2.1 | 2.08336 | 0.006% | 0.846100 | 0.005% | | | | |
| Georges Romney (a) / (b) | 1770 | 95064.1.1 | 2.08066 | 0.010% | 0.846235 | 0.004% | | | | |
| | | 95067.1.1 | 2.08034 | 0.012% | 0.846181 | 0.004% | | | | |
| | | 95064.3.1 | 2.08068 | 0.007% | 0.846171 | 0.004% | | | | |
| | | 95067.2.1 | 2.08046 | 0.005% | 0.846180 | 0.004% | | | | |
| Samuel Alken | 1795 | 95070.1.1 | ~~2.08459~~ | ~~0.005%~~ | ~~0.847125~~ | ~~0.004%~~ | | | | *Ca-load too high |
| | | 95070.2.1 | ~~2.08469~~ | ~~0.005%~~ | ~~0.847116~~ | ~~0.004%~~ | | | | *Ca-load too high |
| JF Sartorius | 1803 | 95073.1.1 | NA | NA | NA | NA | | | | |
| | | 95073.3.1 | 2.08516 | 0.009% | 0.847641 | 0.005% | | | | |
| JW Swift | 1840 | 95076.1.1 | 2.08475 | 0.007% | 0.847587 | 0.004% | | | | |
| William Meadows | 1868 | 95079.1.1 | 2.08480 | 0.011% | 0.847642 | 0.006% | | | | |
| | | 95079.1.1 | 2.08533 | 0.006% | 0.847685 | 0.004% | | | | |
| | | 95079.2.1 | 2.08614 | 0.007% | 0.847964 | 0.005% | | | | |
| Henry Tanworth Wells | 1874 | 95082.1.1 | 2.09029 | 0.013% | 0.850533 | 0.005% | | | | |
| | | 95082.2.1 | 2.09015 | 0.007% | 0.850470 | 0.004% | | | | |
| Sir Arthur Stockdale Cope | 1901 | 95085.1.1 | 2.09078 | 0.006% | 0.849517 | 0.004% | | | | |
| | | 95085.3.1 | 2.09080 | 0.011% | 0.849702 | 0.005% | | | | |
| | | 95085.3.1 | 2.09078 | 0.008% | 0.849683 | 0.005% | | | | |
| | | 95085.5.1 | 2.09070 | 0.007% | 0.849675 | 0.004% | | | | |
| **Title/object - artist** | | | | | | | | | | |
| Eric Magnus Louis Grand Hauteville – By anonymous in style of Amélie Munier Romilly | 1813 | LM-161897 | 2.08438 | 0.008% | 0.847302 | 0.004% | | | | |
| | | LM-161897 | 2.08430 | 0.006% | 0.847298 | 0.004% | | | | |
| | | LM-161897 | 2.08419 | 0.009% | 0.847276 | 0.006% | | | | |
| Adolphe Morand – By Jh. Loretti | 1863 | LM-114651 | 2.08748 | 0.006% | 0.850150 | 0.004% | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Hugo Siegwart – By Carl August Liner | 1907 | LM-158151 | ~~2.09048~~ | ~~0.007%~~ | ~~0.845257~~ | ~~0.005%~~ | | | | *Ca-load to high |
| Preliminary design for “die Wiege der Eidgenosssenschaft” – By Charles Giron | 1899-1902 | LM-161803 | NA | NA | NA | NA | | | | Sample amount not sufficient for analysis |
| Giambattista Somazzl – By anonymous | 1733 | LM-40076 | 2.08220 | 0.006% | 0.847351 | 0.004% | | | | |
| Salomon Ruppert – By Caspar Bachmann | 1797 | LM-7723 | 2.08406 | 0.006% | 0.847597 | 0.012% | | | | |
| Marie Regine Krus-Guérmand – By Joseph Wyrsch | 1783 | LM-52427 | 2.08372 | 0.007% | 0.847336 | 0.004% | | | | |
| Margrit – by Franz Rederer SIK-98511 | 1962 | 88907.3.1 | 2.09410 | 0.004% | 0.849932 | 0.007% | | | | |
| | | 69024.9.1 | 2.09425 | 0.006% | 0.849982 | 0.007% | | | | |



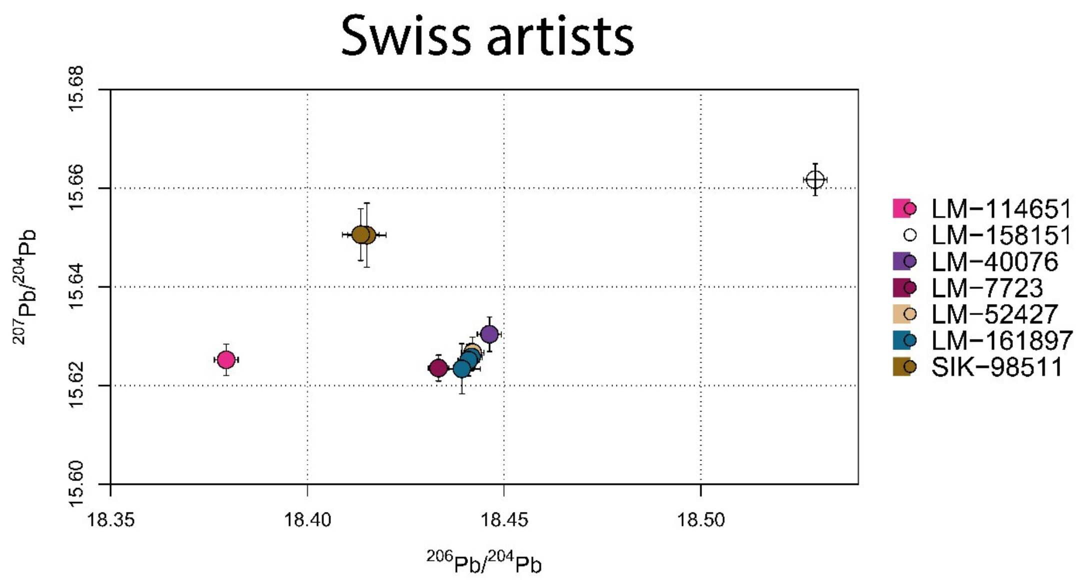




*Figure S-7 Lead isotope ratios (± standard deviation) determined for all the analyzed paintings ($^{206}Pb/^{204}Pb$ vs. $^{207}Pb/^{204}Pb$): orange from British artist (top) and blue from Swiss artists (bottom). They are individually color-coded given by the labels on the side. The empty data points are represent samples where the $CaCO_3$-load can likely bias the lead isotope ratio determination.*

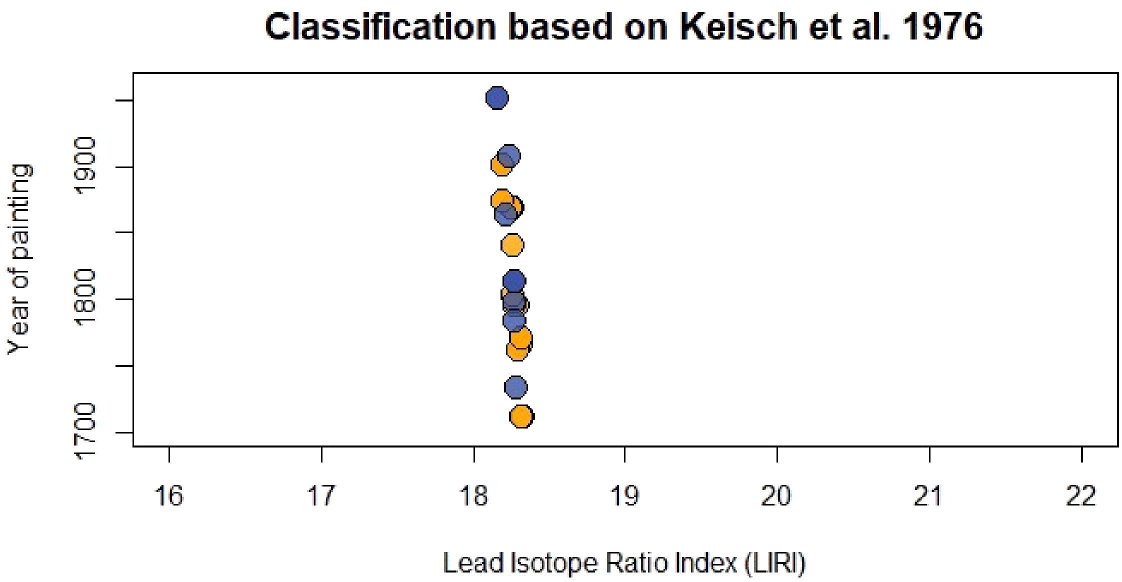



*Figure S-8 Results from the LIRI-data of all the investigated samples (based on Keisch 1976)[18] against the signed date of the paintings; British artists: orange, Swiss artists: blue. The data is lying on a straight line and shows no spread after 1850 as expected from literature[18,19]. The LIRI was calculated based on the following formula: LIRI = 35.385 + 0.4729*($^{206}Pb/^{204}Pb$) - 0.5519*($^{206}Pb/^{204}Pb$*$^{207}Pb/^{206}Pb$) - 8.2561*($^{208}Pb/^{206}Pb$).*

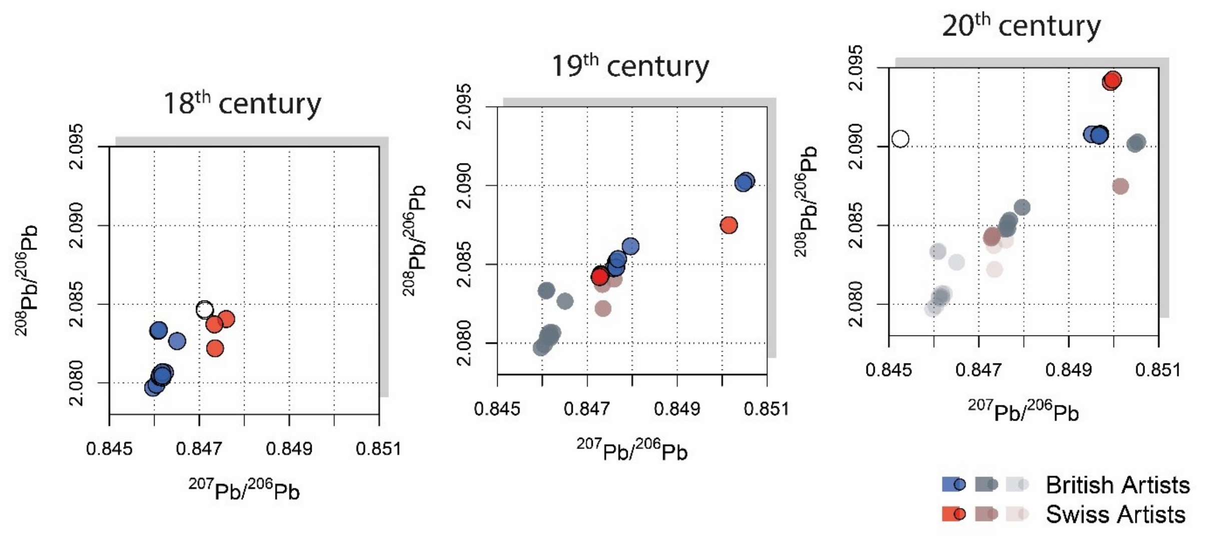



*Figure S-9: Lead isotope ratios for the sample collection of this project ($^{207}Pb/^{206}Pb$ vs. $^{208}Pb/^{206}Pb$). The paintings from British artist are labelled blue, the ones form Swiss Artists are red. The three different plots are separated based on the century of the signed date to the corresponding painting given with the older data points in increasing transparency. The empty data points had to be disregarded, based on their $CaCO_3$-load which affects their true lead isotope ratios. Although these were determined, no error bars representing the standard deviations from the individual measurements are shown in this plot due to their small value compared data points font size.*

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