

# Supplementary Information

## Single- and multi-element quantification and characterization of TiO<sub>2</sub> nanoparticles released from outdoor stains and paints

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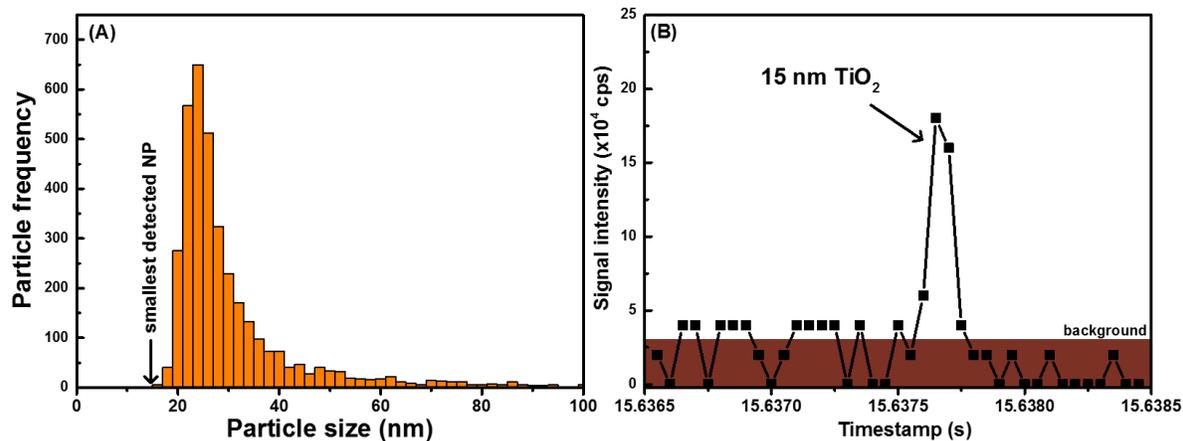
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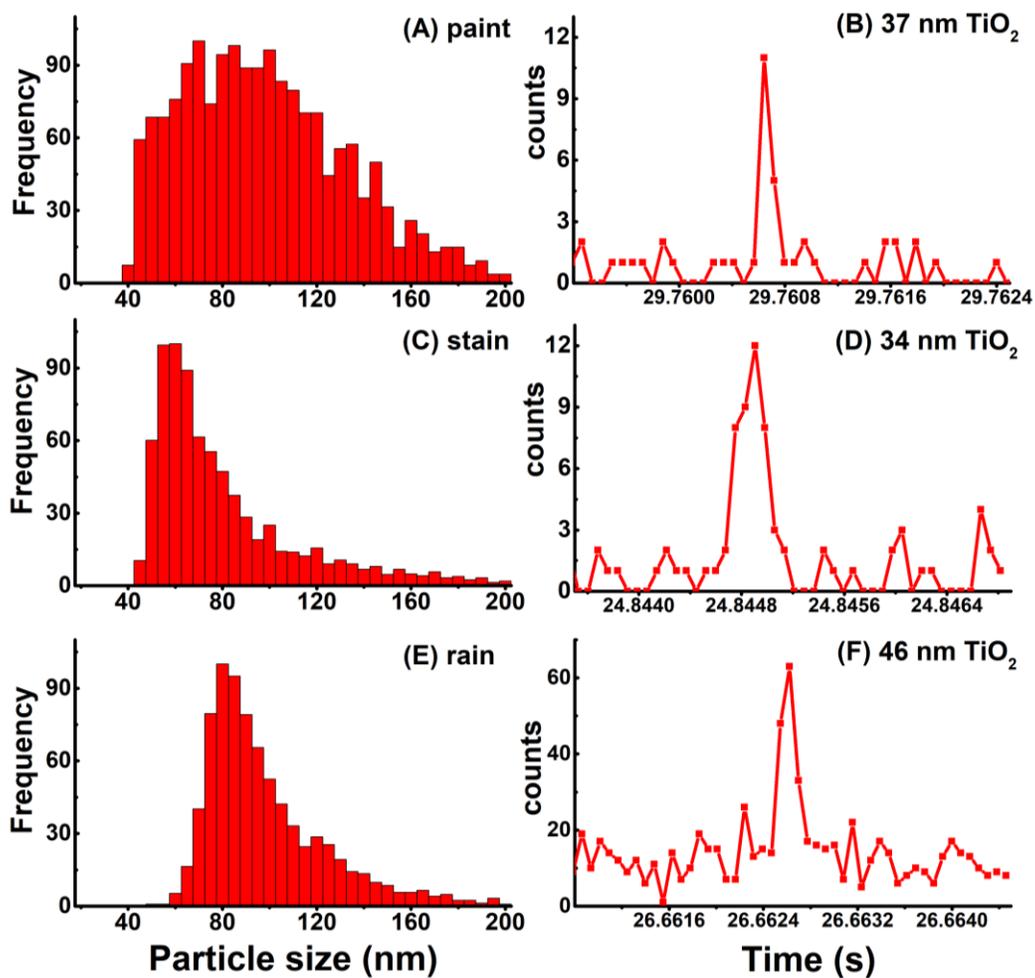
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23 **Figure S1.** (A) Particle size distribution of Ti-containing NPs in a melted snow as measured by a magnetic-  
 24 sector SP-ICP-MS coupled to a desolvator and using a dwell time of 50  $\mu$ s. While the measurable size  
 25 detection limits were below 15 nm, the NP detection thresholds were conservatively set so that 15 nm was  
 26 the smallest detected NP across all samples. (B) an example of the raw ICP-MS signal data for the smallest  
 27 detected NP with a size of 15 nm. Particle diameters were calculated on the assumption that particles were  
 28 solely spherical  $\text{TiO}_2$ .

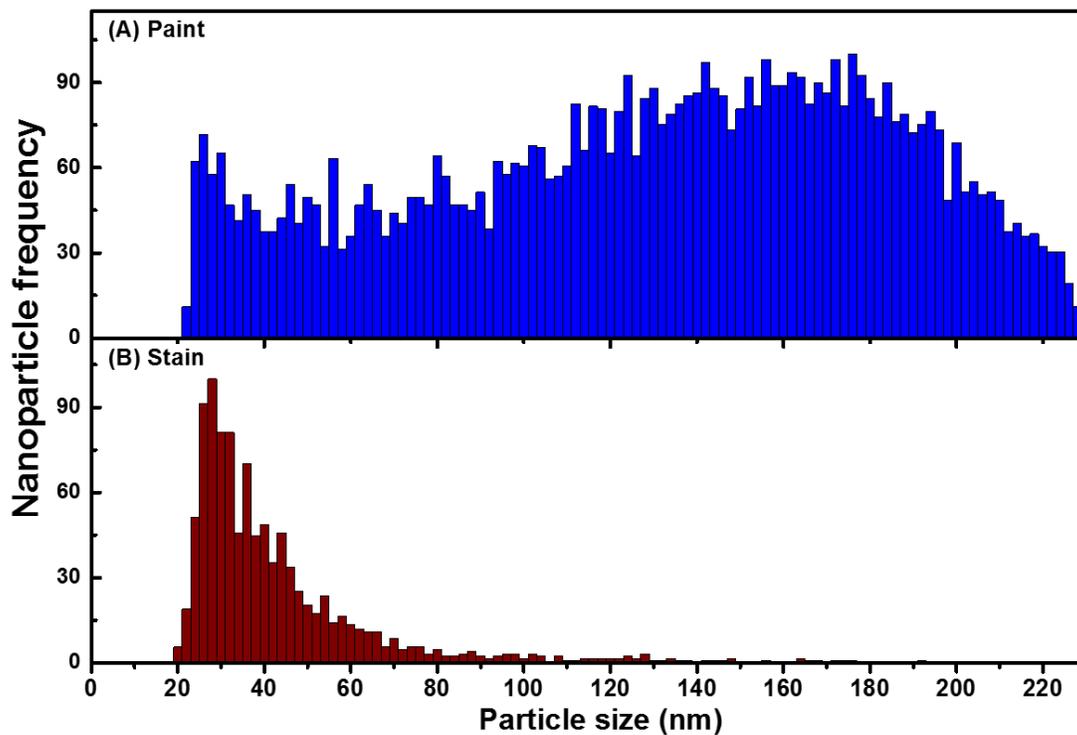


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31 **Figure S2.** Particle size distributions measured using SP-ICP-TOF-MS for Ti-containing NPs in (A) diluted  
 32 paint, (C) diluted stain and (E) rainwater, as well as the raw peak data for NPs that were near the  
 33 instrumental size detection limits. Sizes have been calculated by assuming that Ti-NPs were made up of  
 34 solely spherical TiO<sub>2</sub>.

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37 **Figure S3.** Particle size distribution of TiO<sub>2</sub> NPs in (A) liquid paint and (B) liquid stain, as measured by a  
38 high-resolution SP-ICP-MS. The samples were analyzed immediately following a 2x10<sup>7</sup>x dilution of the  
39 liquid paint and 2x10<sup>5</sup>x times dilution of the stain in Milli-Q water. Particle diameters were calculated on  
40 the assumption that particles were solely spherical TiO<sub>2</sub>.

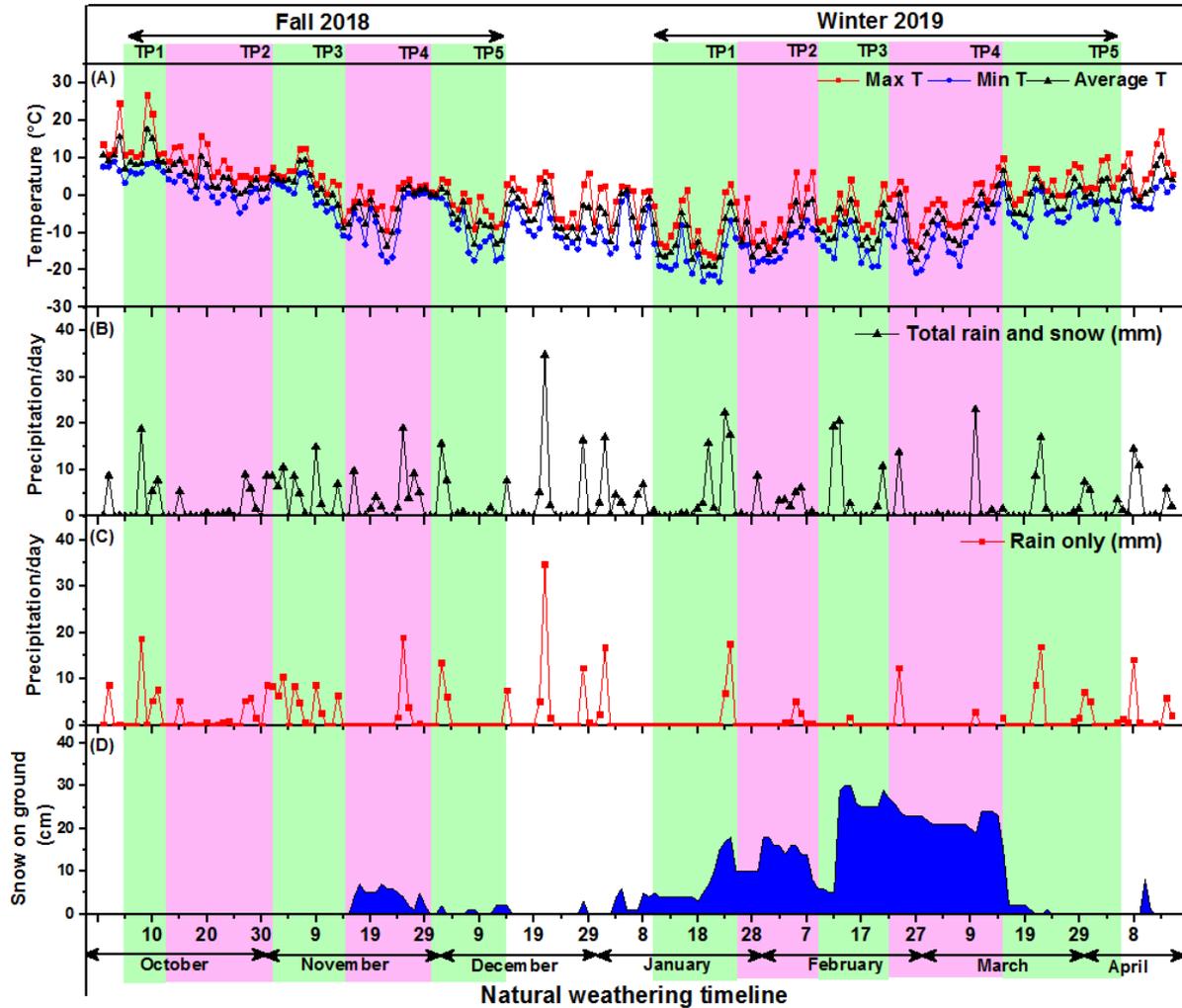
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47 **Figure S4.** (A) Daily temperatures (maxima, minima and mean T), (B) total precipitation (total liquid  
 48 equivalent of rain and snow), (C) rain precipitation and (D) snow on ground data for the fall of 2018 and  
 49 winter of 2019, as collected from the Montreal International Airport weather station (45°28'14.000" N,  
 50 73°44'27.000" W) and retrieved from the Environment and Climate Change Canada database. Timepoints  
 51 (TP) indicate when the respective fall or winter samplings were conducted.

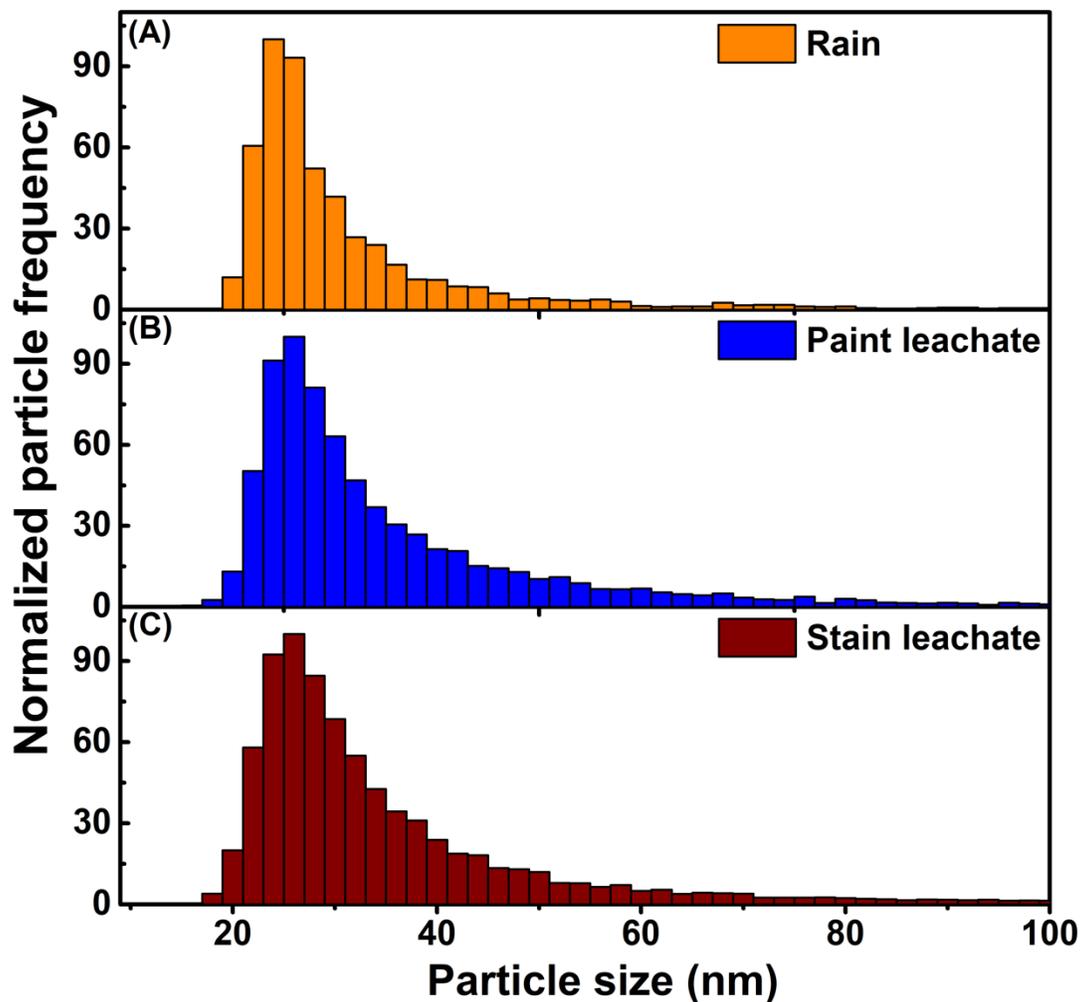
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58 **Figure S5.** Examples of particle size distributions of Ti-containing NPs (A) in a rainwater as well as in the  
59 leachates of (B) paint and (C) stain. NP frequencies in the leachate samples were calculated following the  
60 subtraction of the background NPs (*i.e.* pre-existing NPs in the rainwater). Samples were measured by a  
61 magnetic-sector SP-ICP-MS, and the particle diameters were calculated by assuming that Ti-containing  
62 NPs were solely spherical TiO<sub>2</sub>.

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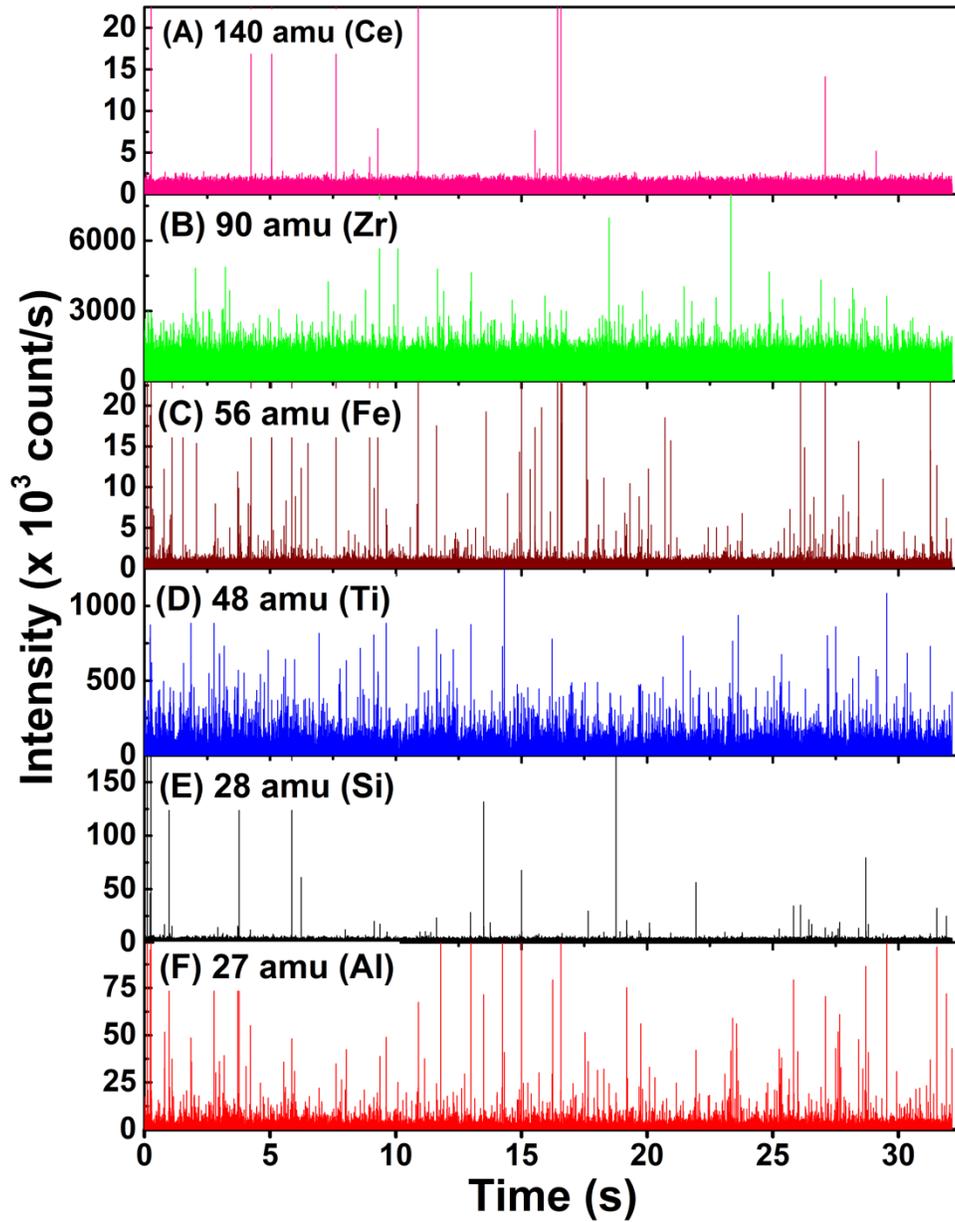
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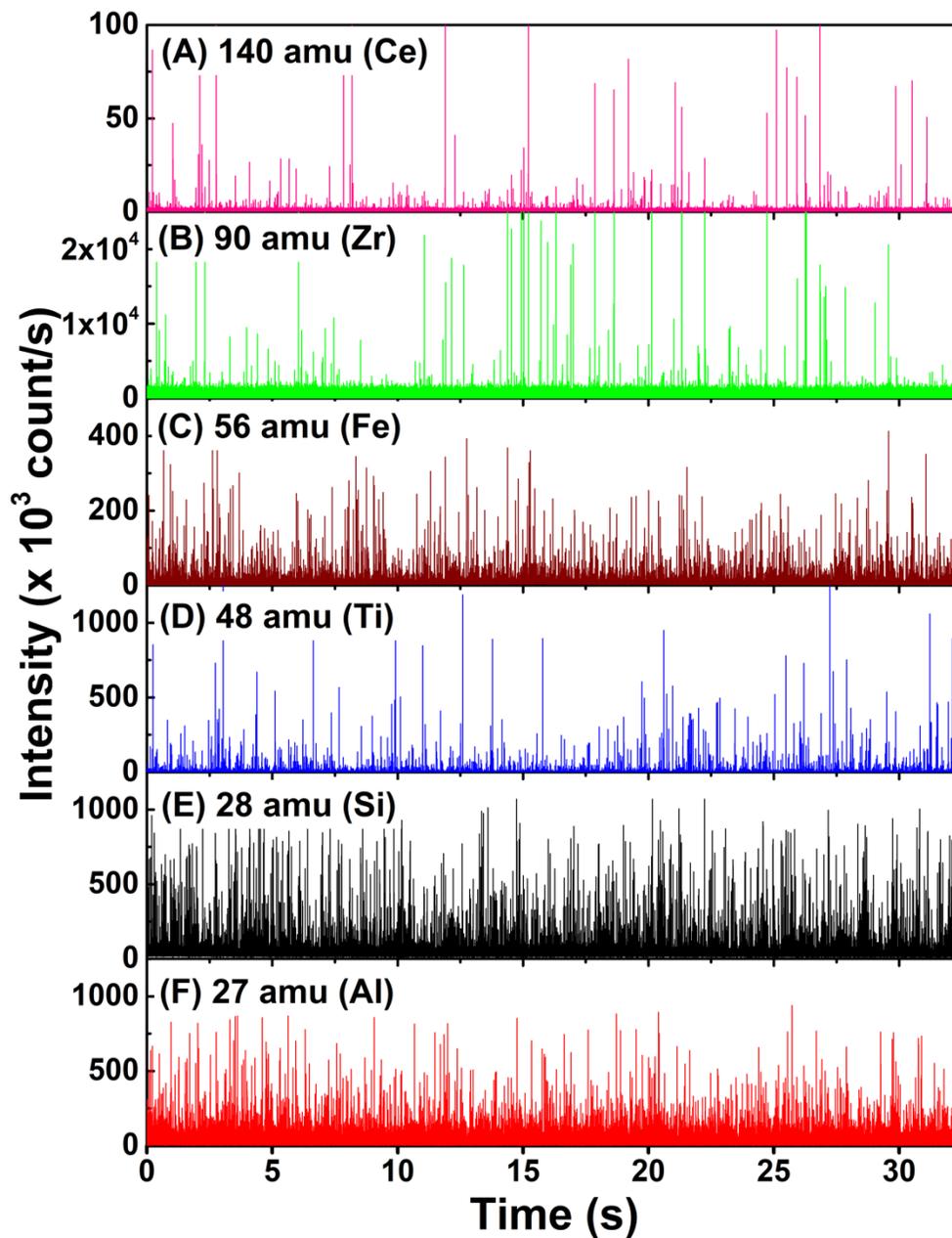
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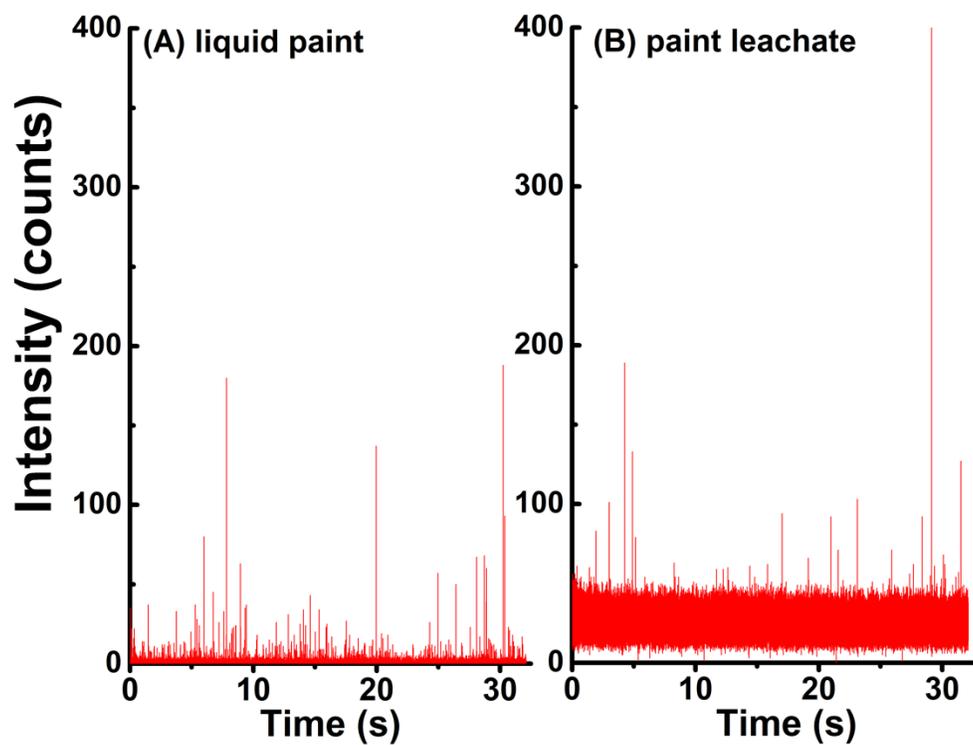
70 **Figure S6.** Time-resolved ICP-TOF-MS signal simultaneously measured for (A) Ce, (B) Zr, (C) Fe, (D)  
71 Ti, (E) Si and (F) Al in liquid paint that was diluted  $2 \times 10^7$  x with Milli-Q water.

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74 **Figure S7.** Time-resolved ICP-TOF-MS signal simultaneously measured for (A) Ce, (B) Zr, (C) Fe, (D)  
 75 Ti, (E) Si and (F) Al in the liquid stain that was diluted with Milli-Q water. While Ce, Zr, Ti, Si and Al  
 76 were measured in  $2 \times 10^4$  x diluted samples, Fe was measured in  $2 \times 10^5$  x diluted samples due to its relatively  
 77 higher concentration.



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79 **Figure S8.** Time-resolved ICP-TOF-MS signal measured for  $^{27}\text{Al}$  in diluted liquid paint ( $2 \times 10^7 \times$ ) and in  
80 the leachate following the weathering of a painted surface in Milli-Q water.