A campaign was conducted to assess personal exposure of coarse (2.5-<10μm) and fine (d=<2.5μm) PM for two lines of the L.A. Metro— a subway (red) and light-rail (gold) line. Concurrent measurements were taken at University of Southern California (USC) to represent ambient conditions. A comprehensive chemical analysis was performed utilizing aerosol and water-soluble metals, inorganic ions, elemental and organic carbon, and organic compounds. Mass balance showed that in coarse PM, iron makes up 27%, 6%, and 2% of gravimetric mass for red line, gold line, and USC, respectively; in fine PM, iron makes up 32%, 3%, and 1%. Ambient air is the primary source of inorganic ions and organic compounds for both lines. Non-crustal metals, particularly Cr, Mn, Co, Ni, Mo, Cd, and Eu were elevated for the red line and, to a lesser degree, the gold line. Mo exhibited the greatest crustal enrichment factors. The enriched species were less water-soluble on red line than corresponding species on gold line. Bivariate analysis showed that reactive oxygen species (ROS) activity is strongly correlated with water-soluble Fe (R²=0.77), Ni (R²=0.99), and OC (R²=0.92). A multiple linear regression model (R²=0.94, p<0.001) using water-soluble Fe and OC as predictor variables was developed to explain the variance in ROS. In addition, PM from red line contains 85% and 55% more ROS activity per m³ atm than PM from USC and gold line, respectively; however, one unit of PM mass from gold line may be as intrinsically toxic as one unit of PM from the red line.

1. PM mass balance

![Figure 1](image1.png)

**Figure 1.** Mass reconstruction of 7 identified categories for the gold line, red line, and the USC ambient site in (A) coarse PM and (B) fine PM. WISC: water-soluble inorganic carbon; WISOOC: water-insoluble organic carbon; EC: elemental carbon; trace metals: all metals measured with ICP-MS less Fe and crustal metals: crustal metals less Fe; Al, K, Ca, Mg, Ti, and Si with applied oxide correction factor; ions: Cl⁻, NO₃⁻, SO₄²⁻, NO₂⁻, Na⁺, K⁺, NH₄⁺.

2. Crustal and non-crustal elemental concentrations

![Figure 2](image2.png)

**Figure 2.** Upper Continental Crustal (UCC) enrichment factors for (A) coarse PM and (B) fine line in descending order of the USC site.

**Table 1.** Mass concentrations of crustal and non-crustal elements and ratios of gold and red line sites to USC ambient site.

3. Upper Continental Crustal (UCC) enrichment factors (EFs)

![Figure 3](image3.png)

**Figure 3.** Reactive oxygen species (ROS) activity shown as (A) per unit volume (m³) and (B) per gram gravimetric PM mass (mg)

**Table 2.** ROS coefficients of determination (R²)

4. Reactive oxygen species (ROS) activity

- **Multiple linear regression.** We elected W5S Fe and OC as our two independent variables to be predictors of ROS activity because they represent distinct pollution sources and have also been shown to be redox active (Verma et al., 2010). The statistically significant regression equation resulted in the following equation:

\[
\text{ROS} = 16.624 + 0.663 \times \text{Fe} + 0.0318 \times \text{OC}
\]

- The overall model is statistically significant (p<0.001) and has an adjusted R² = 0.94. Correlation between measured and predicted ROS values is excellent (R² = 0.96) [predicted ROS] = 0.96[measured ROS] + 3.41. Results suggest that WS Fe, a PM species present in elevated concentrations in rail environments, and OC, an indicator of ambient vehicular traffic, can explain 94% of the variance of measured ROS activity.

**References**


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