David Luglio. **PM_(2.5) concentration and composition in subway systems in the Northeastern United States.**

Background. Subways are integral parts of the infrastructure of large urban centers around the world. They move millions of people daily in an efficient manner. Yet, these underground transit systems are notorious for their grime and filth. Many studies have demonstrated subway platforms have PM_(2.5) concentrations that are several times ambient concentrations. Some subway studies have reported high concentrations of airborne metals. Increased exposure to ambient PM_(2.5) and metals are associated with adverse health effects, such as the development of asthma and cardiovascular disease. Subway air pollution should thus be concerning, yet few studies have evaluated PM_(2.5) concentrations and particle composition in the major transit systems of Northeastern United States.

Methods. Using light scattering and filter-based methods, real-time and gravimetric PM_(2.5) concentrations were evaluated at 71 stations across 12 transit lines in the Philadelphia, Boston, Port Authority Trans-Hudson (PATH-NYC/NJ) and Metropolitan Transit Authority (MTA-NYC) of New York City/Jersey City, and Washington, DC subway systems. PM_(2.5) composition was determined by X-ray fluorescence and organic-elemental carbon analysis on Telfon and quartz filters, respectively. Additional speciation (elemental oxidation state and mineralogy) were performed on the Teflon filters with a synchrotron beam.

Results. PM_(2.5) concentrations at underground stations were several times higher than at aboveground, street-side locations, as well as compared to aboveground stations and in train-cars. Significant inter-transit system and inter-station differences in PM_(2.5) concentrations were observed. Mean + SD real-time concentrations in underground platforms were 779Â±249, 548Â±207, 341Â±147, 327Â±136, and 112Â±46.7â€‰Î¼g/m^3 for the PATH-NYC/NJ; MTA-NYC; Washington, DC; Boston; and Philadelphia transit systems, respectively. The highest mean gravimetric concentrations were observed at a PATH-NYC/NJ station, 1,020 Î¼g/m^3, including two 1-hour integrated values of approximately 1,700 Î¼g/m^3. Iron contributed at least 30% and upwards of 60% of mass of the PM_(2.5) in each system. Others metals and carbon were measured at considerable concentrations. Initial speciation results indicate that much of the iron is in the Fe^3+ state and found in mineral forms most associated with rust.

Conclusions. The major finding of this study was that PM_(2.5) concentrations are elevated in underground subway stations compared to ambient and other transit aboveground settings. This subway PM was metal-rich, most notably in iron-rust. Importantly, exposure to these PM_(2.5) concentrations may prove a health risk for both transit workers and commuters, especially to those people utilizing or working in subway stations in NYC. Particular concern should be paid to workers who spend multiple hours underground each work day. For effective remediation purposes, further research is required to clearly identify the sources of the underground subway air pollution and to evaluate the potential toxicological effects upon exposure to these subway-derived particles. Physiological health studies of workers and commuters are paramount given the findings in this study.