

# The Fate of Combustion-Derived Carbon Deposition in Urban Soil

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## INTRODUCTION

- Polycyclic aromatic hydrocarbons (PAHs) are immunotoxic and carcinogenic compounds that are commonly produced from combustion sources (vehicle exhaust, fires, cooking).
- Urban soils are increasingly exposed to deposition of carbon-based pollution from non-point sources. These contaminants may be a resource for urban soil microorganisms, modifying microbial community structure and function.



## QUESTION

What is the magnitude, distribution, and fate of PAHs in highway soils of a low-density, arid urban area?

## HYPOTHESES

- Number of sources (traffic density) and proximity to source (distance to the road) will predict PAH concentration in soils.
- Future experiments: PAH concentration may also be determined by:
  - Microbial metabolism:** Because soil microbes use reduced carbon compounds for growth, microbes adapted to high PAH concentrations may be able to metabolize these complex carbon compounds.
  - Climate/Environment:** Solar irradiation, temperature, and precipitation may alter degradation, accumulation, and transportation dynamics of PAHs.
  - Anthropogenic modification of soil properties** that may affect carbon sequestration in soils, including soil moisture, pH, and road features (pavement type, age of highway, landscape slope).

## References

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## METHODS

- During summer 2008, 63 sites were chosen from Phoenix metropolitan area highways (Fig. 1). One sample from each site consisted of three homogenized soil cores, collected from the top 2 cm of soil, taken 0.5 meters away from the side of the road.
- Five sites were used for additional soil sampling at intervals of 0.5, 1.5, 5.0, and 15 m away from the road using perpendicular transects.



Fig. 1. Map of soil sampling locations in the Phx valley.



Fig. 2. Samples after ultrasonic solvent extraction.

- Soil samples were analyzed for soil properties and PAH concentrations. After sample preparation and cleanup methods, PAH compounds were identified and quantified with a GC-MS (Fig. 2). To date, 35 of 83 samples have been quantified.

## RESULTS

- Concentrations of PAH compounds in the Phoenix metropolitan area are low compared to other cities worldwide (Table 1).
- Preliminary data (n = 15 of 63) show high variability and no correlation between traffic density and PAH concentration.

Study Location	Σ 12 PAH concentration (ug/kg)	Mean max temp. (F)	Annual precipitation (inches)
Bangkok, Thailand <sup>2</sup>	250	32.78	55
<b>Phoenix metropolitan area, AZ</b>	<b>1,155</b>	<b>30.42</b>	<b>8.4</b>
Brisbane, Australia <sup>4</sup>	3,300	25	45
Agra, India <sup>1</sup>	12,900	31.67	27
Los Angeles, CA, US <sup>3</sup>	58,680	23.89	15

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- PAHs may preferentially deposit or otherwise remain in soils near roads, although, due to high variability of PAH compounds between sites, a larger sample size is necessary for increased statistical power. (Fig. 3.)

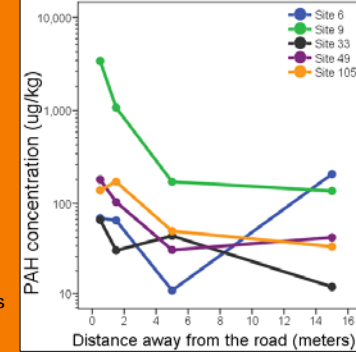


Fig. 3. Concentration of PAHs on a distance gradient at five highway sites.

## DISCUSSION/CONCLUSION

- Preliminary data suggest that PAH concentrations in Phoenix soils are nearly an order of magnitude **lower** than expected based on data from other, more densely populated cities.
- High variability between preliminary samples obscures relationships between soil PAH concentrations, traffic density, and distance to roads.
- Both abiotic and biotic factors may control PAH retention in urban soils.

## FUTURE WORK

- We plan to use molecular fingerprinting techniques to explore the effects of urban deposition on microbial community structure and function of specialized degrader microorganisms in urban soils.
- We will also test other factors controlling PAH concentrations, such as effects of photodegradation (UV radiation) on PAH breakdown.
- Application to socio-ecological issues: In our complete valleywide analysis, we will explore the relationship between soil PAH concentrations and social factors such as income and ethnicity.