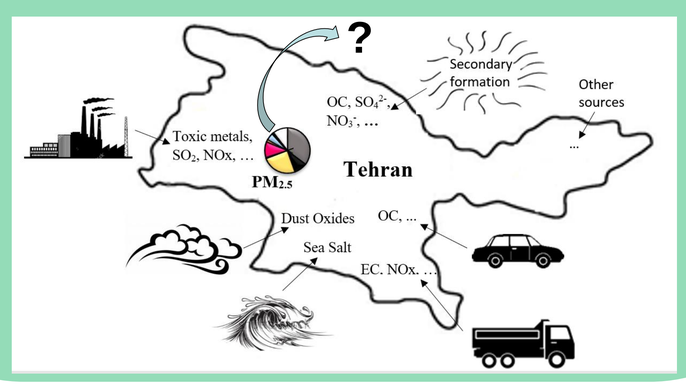
Carbonaceous, Organic and Toxic Metals Components of Particles and Their Seasonal Trends in Tehran, Iran

Mohammad Arhami [a], Vahid Hosseini [a], Maryam Zare Shahne [a], Alexandra Lai [b], James J. Schauer [b]

[a] Sharif University of Technology, Tehran, Iran
[b] University of Wisconsin-Madison Madison, WI, USA

INTRODUCTION AND OBJECTIVES

Tehran megacity, capital of Iran and the nation largest metropolitan area, is one of the world's most polluted cities. During recent years about one-third to half of the days each year were reported polluted, mainly due to $PM_{2.5}$ exceeding national standard levels. These particles contain chemical contents such as organic trace elements, toxic metals and carbonaceous components particularly in the nanoparticles size fractions with major effects on population health. Hence, it is essential to determine the components of these particles. The present study aims to identify the major components including organic and elemental carbon and heavy metals of $PM_{2.5}$ and their temporal variations in Tehran.



METHODOLOGY

Sampling sites

- **Sharif University of Technology** (residential station), in central-west part of Tehran (35.7° N and 51.4° E).
- This air quality station is a part of Tehran's air quality station network operated by Air Quality Company.

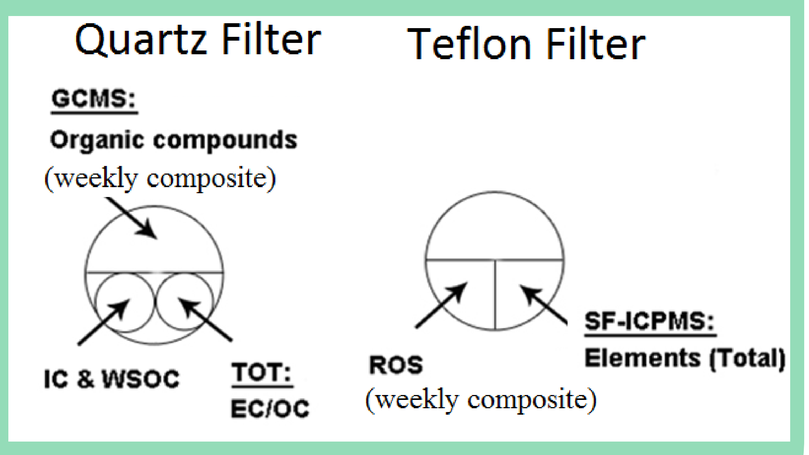
Equipment

- Two sets of samples were collected concurrently on **quartz fiber** (47 mm diameter, Whatman Inc.) and **Teflon filters** (47 mm diameter, PTFE Teflon, Pall Life Science)
- Two **low-volume ambient air samplers** (PQ200 by BGI, Inc., USA).

Sampling schedule

- **24-hour** $PM_{2.5}$ samples were collected in Tehran **every 6 days** for a **full year** from February 2014 to February 2015.

Chemical analyses

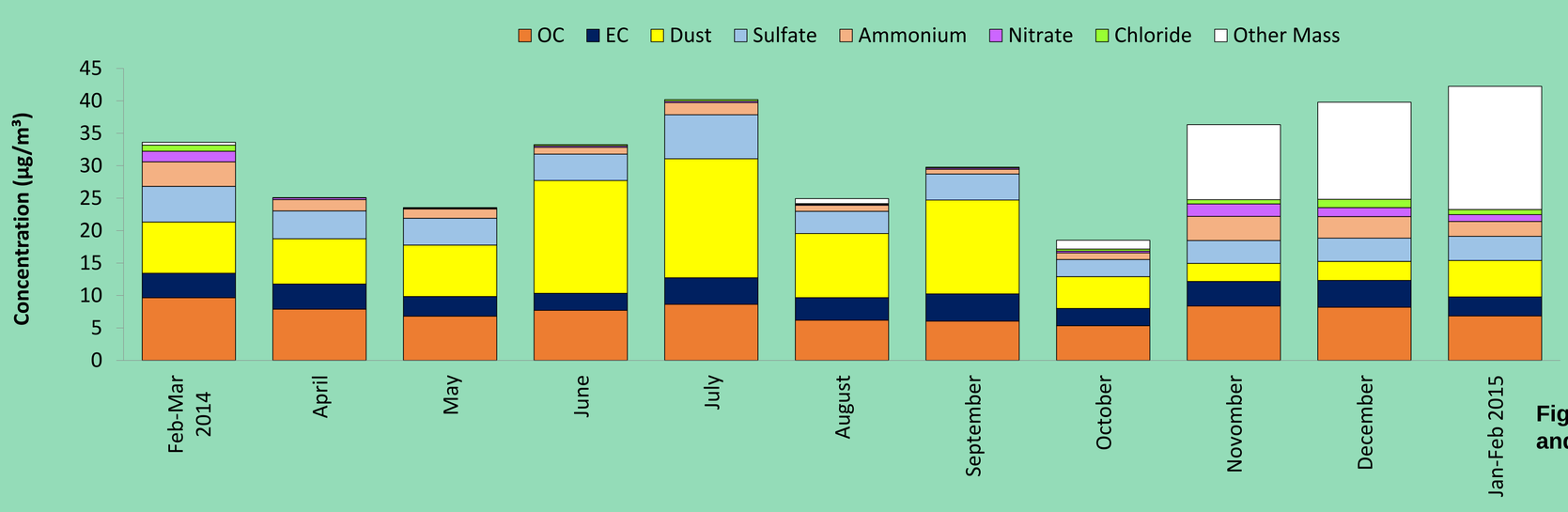


RESULTS AND DISCUSSION

The main constituent of airborne particles were determined to be **carbonaceous components** (organic matter and elemental carbon) with mean contribution and concentration of 47% and 11.32±2.52 μgm^{-3}, respectively.

Organic matter and EC together comprised 44% of fine PM on average (increased to >70% in the colder season), indicates the significance of **anthropogenic urban sources** in Tehran (mainly combustion by mobile sources), which are also known as important sources of nanoparticles.

The contributions of dust components varied considerably throughout the year: from 7% in the cold season to 56% in the hot and dry season.



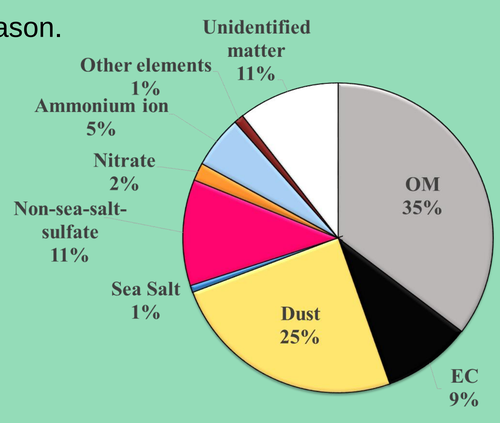


Figure 1. Chemical composition of ambient fine particulate matter and annual contribution of major mass constituents Tehran

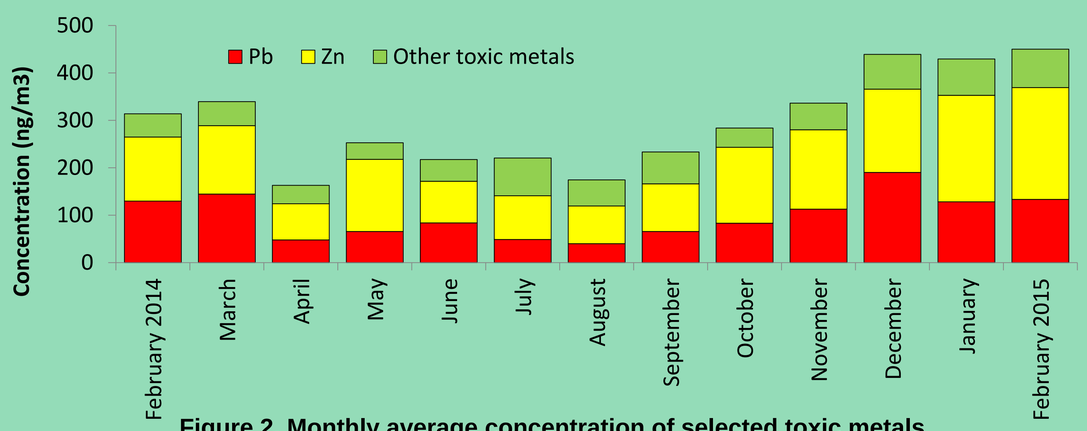


Figure 2. Monthly average concentration of selected toxic metals

The most abundant heavy metals were **Zn and Pb**, with maximum monthly averages of 0.23 and 0.19 $\mu g/m^3$, respectively.

These components generally had higher levels in cold seasons due to several reasons such stable atmospheric conditions.

Most of these metals and organics are mainly originated from **fuel oil combustion, break abrasion, and tire wear**.

The variations of PAHs levels are presented in Fig 3. Annual average concentration of total PAHs in samples was 10.10±0.47 ng/m^3. Although the total concentrations of PAHs, with a mean contribution of 0.03 % play a minor role in $PM_{2.5}$ mass in Tehran, they potentially can have a destructive effect in human health because of their carcinogenicity.

High levels of these PAHs were obtained in **cold months**, particularly in February, where concentrations reached up to four times more than levels recorded in summer. Total PAH concentration varied from 3.92 ng/m^3 during warmer season to 20.09 ng/m^3 during winter time. These components are common product of **incomplete combustion**, since aromatic rings formed mainly during incomplete combustion of fossil fuels, explaining higher winter time concentrations

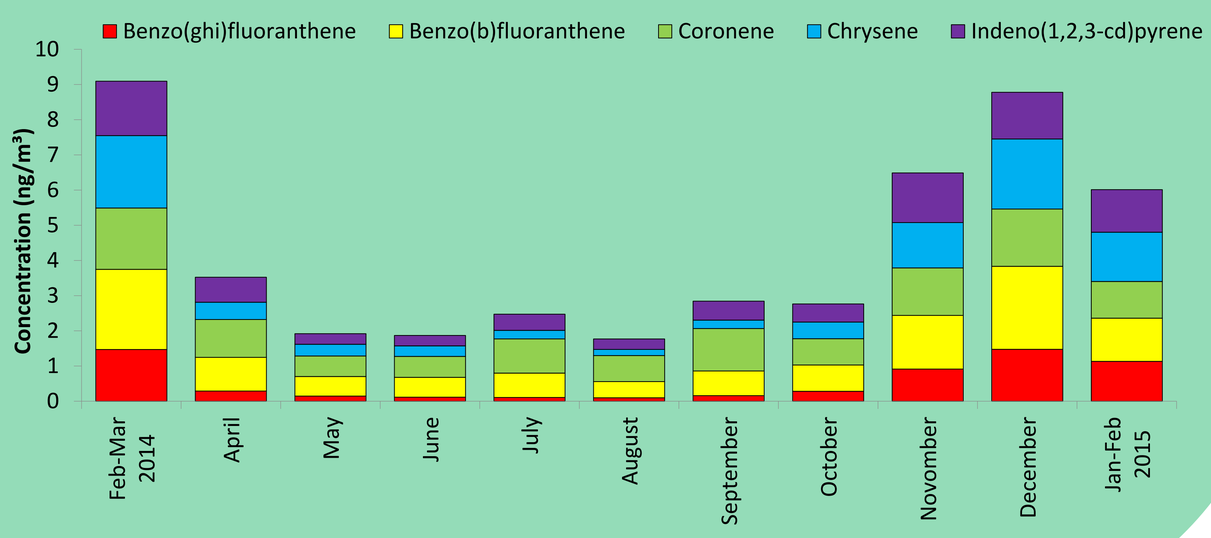


Figure 3. Monthly concentrations of main PAHs in Tehran

ACKNOWLEDGEMENTS

The authors would like to acknowledge the Air Quality Company manager and staff for providing the samplers and granting access to the Sharif air quality station and its data. We would also like to thank Mr. Najafi and Hassankhani for their important contributions to the field campaign.

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