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The Impact of Polluting Chemical Compounds Resulting From the Gases Exhausted by Road Vehicles in Urban Environment

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Objectives

- **Introduction on urban air pollution**
- **Materials and methods and assessment planning**
- **Results/ data from measurements**
- **Discussions – data interpretation**
- **Conclusion**

Introduction - urban air pollution

- Urban Air quality is one of the most discussed topics in research worldwide today.
- Among the main pollutants are particulate matter (PM) and volatile organic compounds (VOCs) generated in the atmosphere by road traffic and socio-industrial activities .
- PM10 and PM2.5 are particles with aerodynamic diameters equal to or less than 10 µm and 2.5 µm respectively that trap other toxic/dangerous substances on their surface like
- heavy metals (Pb, Cd, Ni, As),
- exhaust gases,
- aromatics. polycyclic hydrocarbons,
- viruses, pollen, bacteria, viruses and otherorganic compounds

introduction

- Most particulate matter related to road vehicle traffic has two natural sources,
- such as street dust, which is highly mineralised from soil particles and
- particles generated directly from car exhaust, such as soot and other combustion residues
- Another component of particulate matter related to vehicle traffic is
- oxide material from rusting car chassis

Under Directive 2008/50/EC, the European Commission has proposed two stages of changes to the $PM_{2.5}$ limit thresholds, which means that

- from 1 January 2015 the maximum limit is 25 $\mu g/m^3$ and
- from 1 January 2020 the maximum limit for fine fractions is 20$\mu g/m^3$
- In Romania, the coding system of the National Monitoring Network for Air Quality Monitoring Network establishes the hazardous level of particulate matter.
- Air quality starts to deteriorate from concentrations of

around 50 $\mu g/m^3$ for PM_{10} and 25 $\mu g/m^3$ for $PM_{2.5}$

when the quality index becomes medium to bad and very bad.

Materials and methods

- this research focuses on the correlation of values measured in the field, in the city of Alba Iulia, Romania, with physico-chemical investigations carried out on samples of street dust from the area adjacent to the measurements and on floating particles collected from the atmosphere.
- This article is part of environmental research on air pollution in the city of Alba Iulia, Romania, conducted over several months during 2022.
- The most important areas of measurement of environmental parameters that are placed on the map

- Total VOC and CO2 emissions to the atmosphere were measured using a portable UNI-T UT 338C Air Quality Meter
- PM10 and PM2.5 levels were measured with a portable DUST
- The total time of measurement for each point was 10 minutes and three measurements were performeddifferent readings and the mean value was considered representative.
- It wascounted the total number of passing vehicles during the measurement.

May 2022

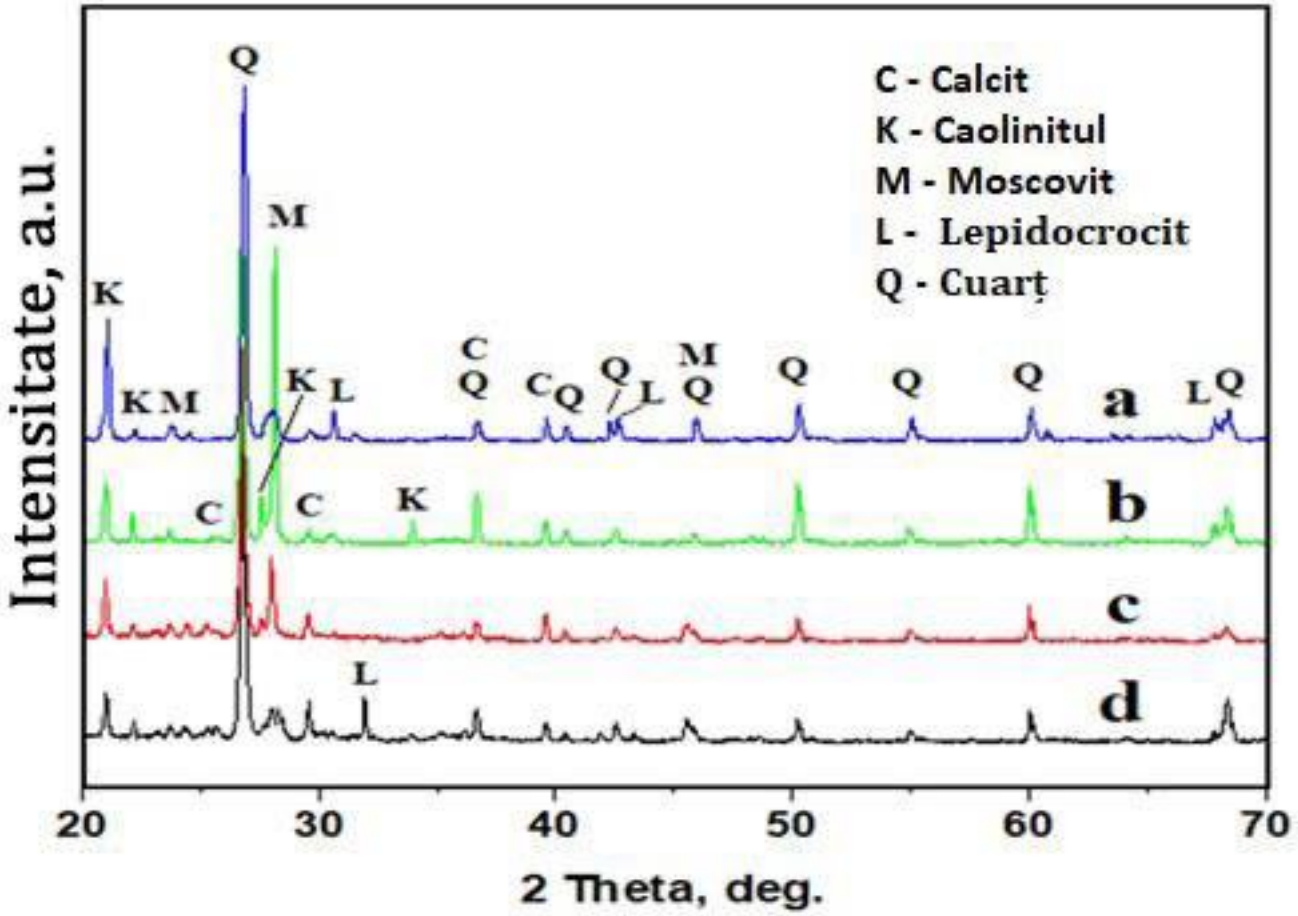
Point of measurement	$PM_{2,5}$ µg/m^3	PM_{10} µg/m^3	VOC µg /m^3	CO_2 ppm	Nr. auto-vehicles
1	38	36	6.8	608	59
2	28	38	0.5	556	48
3	49	55	1.2	558	65
4	36	48	1.6	556	46
5	32	33	0.2	550	57
6	36	31	0.4	580	55
7	38	41	0.2	539	44
8	36	40	0.4	560	57
9	42	45	0.2	552	48
10	46	30	0.4	638	50
11	34	32	0.2	525	44
12	38	36	0.2	506	44
13	32	45	3.1	562	38
14	34	43	1.3	585	44
15	33	39	0.5	600	42
16	47	33	1.2	516	54
17	36	44	3.1	562	46
18	53	49	1,3	585	63
19	46	44	0,5	600	54
Average	38.63	40.21	1.436	561.53	50

September 2022

Point of measurement	$PM_{2,5}$ µg/m^3	PM_{10} µg/m^3	VOC µg /m^3	CO_2 ppm	Nr. autovehicles
1	70	95	6.4	608	74
2	70	93	9.0	686	73
3	68	90	4.1	448	68
4	63	72	3.1	448	64
5	35	42	0.2	445	48
6	30	36	0.2	597	-
7	35	41	0.2	399	-
8	40	44	1.6	415	48
9	35	40	0.2	405	-
10	68	87	1.4	562	74
11	49	64	1.1	439	-
12	46	56	2.5	429	63
13	32	51	0.5	445	-
14	43	50	0.3	415	-
15	66	78	0.6	463	67
16	48	56	0.5	460	-
17	44	54	0.2	426	-
18	84	92	2.5	469	74
19	95	105	0.2	495	-
Average	53.73	65.57	1.82	455.44	65.3

Evaluation of mineral compounds

- the most important method of investigation for the identification of crystalline compounds and phases is X-ray diffraction



XRD patterns for the investigated samples: a) SD1, b) SD2, c) FP1 and d) FP2.

- Sample SD1 has the dominant peak for Quartz, followed by clay particles (such as kaolinite and muscovite) and calcite from degraded soils in green spaces around streets.
- The lepidocrocite(also called **hydrohematite)** found in sample SD1 indicates a anthropogenic source in the rust on the car
- The SD2 event has two very intense peaks one for Quartz and the other for Muscovite, which indicates the origin of this street dust in a very friable sandy-clay soil which easily allows the particles thatspread if not properly moistened. chassis, which has been reported in the literature

- Diffraction patterns obtained for floating particle samples,

FP1 and FP2, show that quartz is the dominant mineral in

FP samples, followed by the mixture of muscovite clay and calcite.

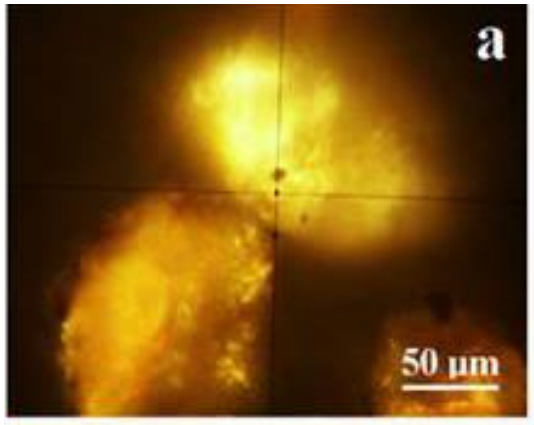
- It is direct evidence that degraded soil is incorporated into the dust and its particles are suspended in the atmosphere due to traffic conditions.

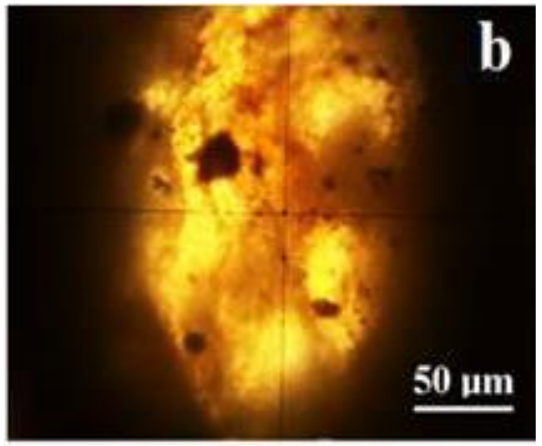
XRD și MOM

Componenta	Cuart	Caolinitul	Muscovit	Calcit	Lepidocrocit
Formula	SiO_2	$Al_2Si_2O_5(OH)_4$	$KAl_2(AlSi_3O_{10})(F,OH)_2$	$CaCO_3$	$\gamma FeO(OH)$

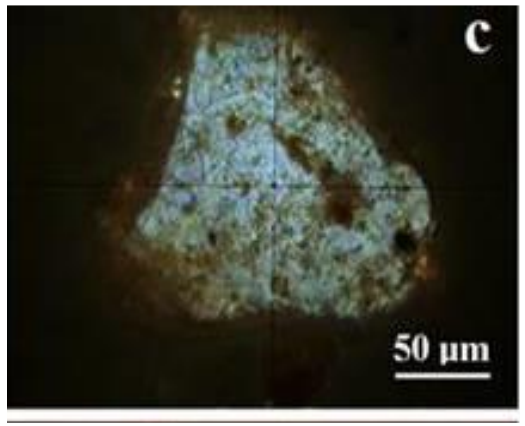
Polarized light images of representative minerals found in samples

- a/b calcite with soot spot

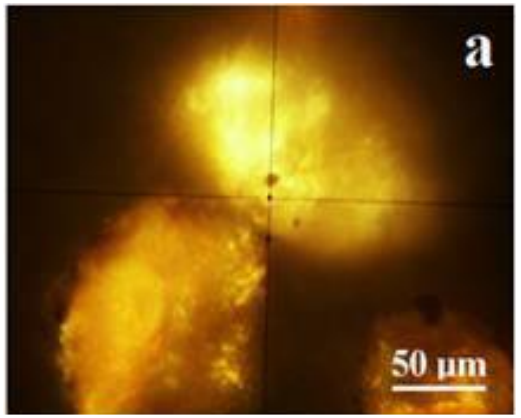




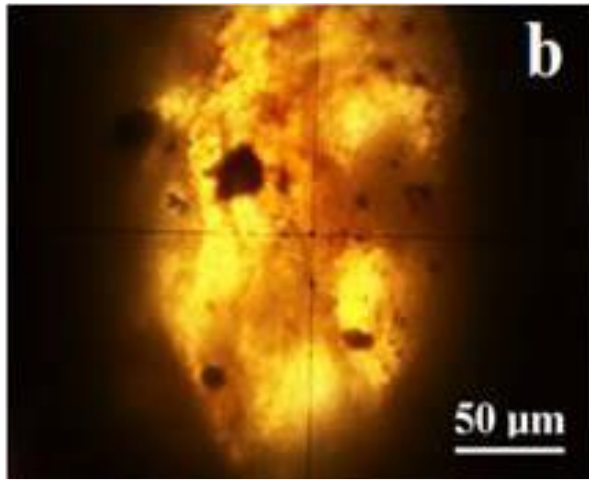
- C - kaolinite

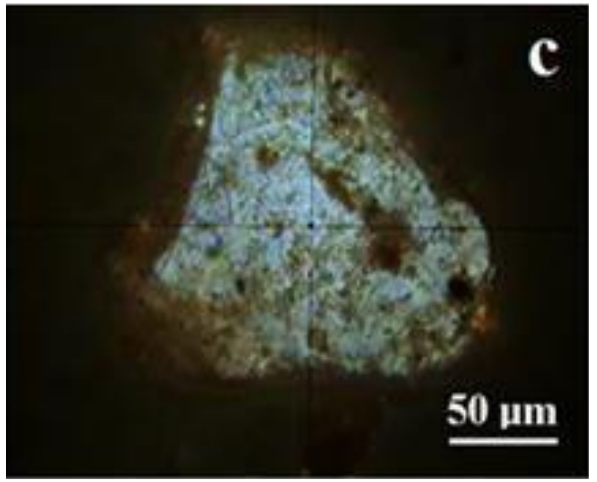


- d - muscovite



Lepidocrit (e) and quartz(f)





Lepidocrocite is a
iron hydroxide, and the specific colour shade is based on the shade
red-orange, part of the
a macroscopic particle that is related to machine rust.

Conclusion

- Physico-chemical investigations show that airborne particles, including PM2.5 and PM10, contain significant amounts of mineral fractions from street dust and organic soot particles.
- This results in PM10 contains predominantly quartz and calcite and traces of clay particles,
- PM2.5 contains predominantly muscovite and kaolinite particles and traces of quartz, calcite and lepidocrocite.
- Soot particles are found as small clusters of micron clusters that mainly proliferate in the PM2.5 category, but some of the
- some are found in PM10. The presence of soot and related VOCs was confirmed

Conclusions 2

- The results indicated that the most effective mitigation strategy foris to reduce the occurrence of dust on the street by better mitigating

green areas adjacent to streets and an improved dust control programme and street cleaning.

The mitigation strategy for organic compounds and

soot is the implementation of modern filters and catalytic systems on vehicle exhaust systems.

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Thank you for the kind attention!