

Éléments du groupe du platine et terres rares dans les poussières de chaussée

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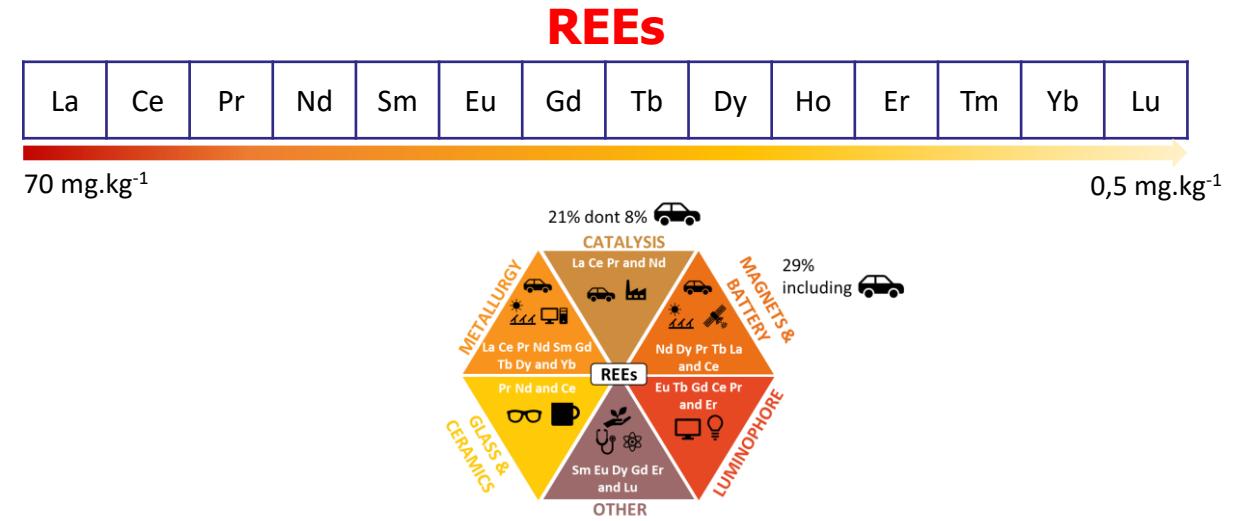
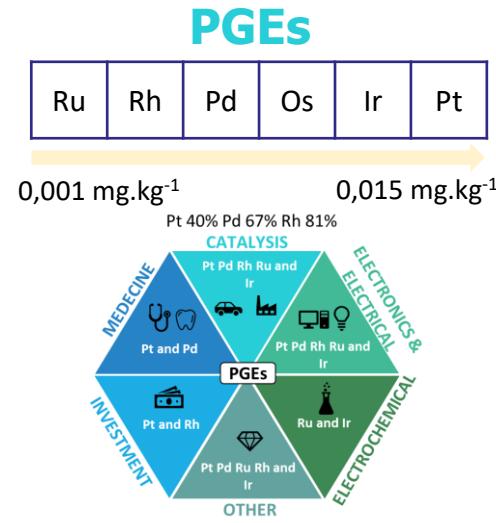
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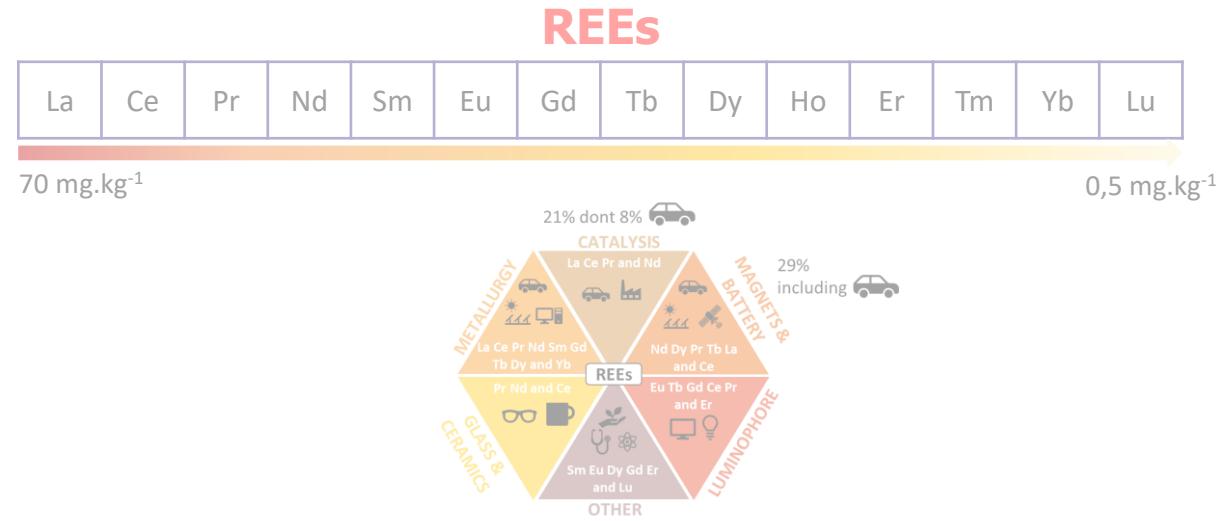
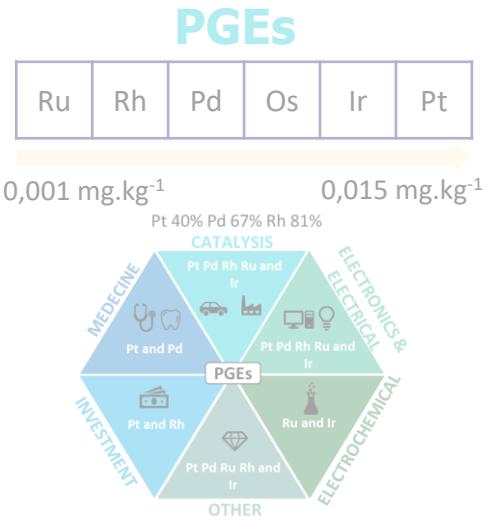
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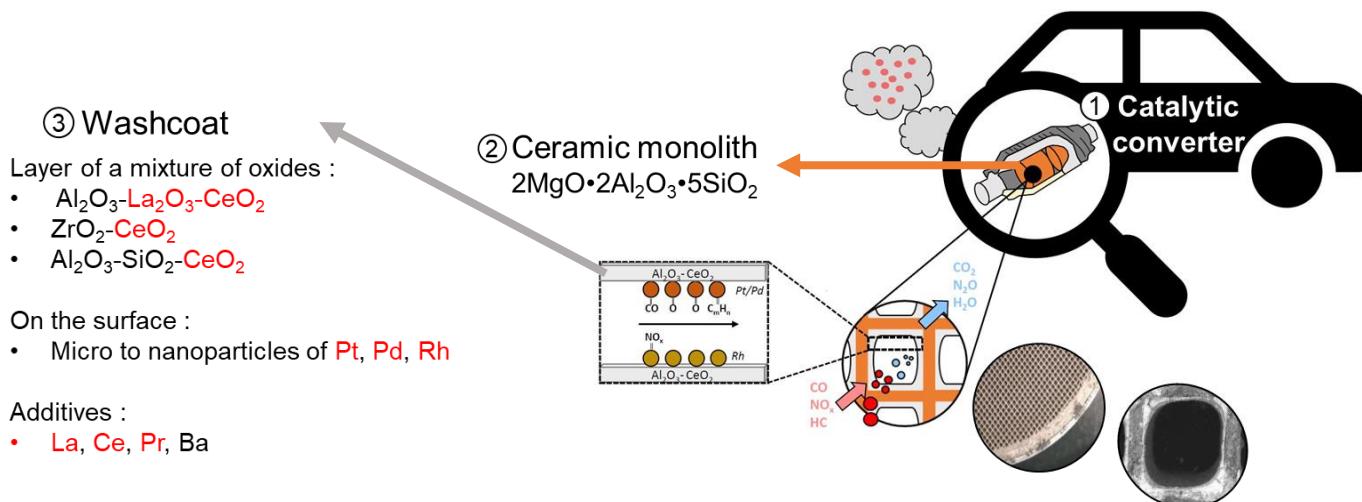
Platinum Group Elements (PGEs) and Rare Earth Elements (REEs)



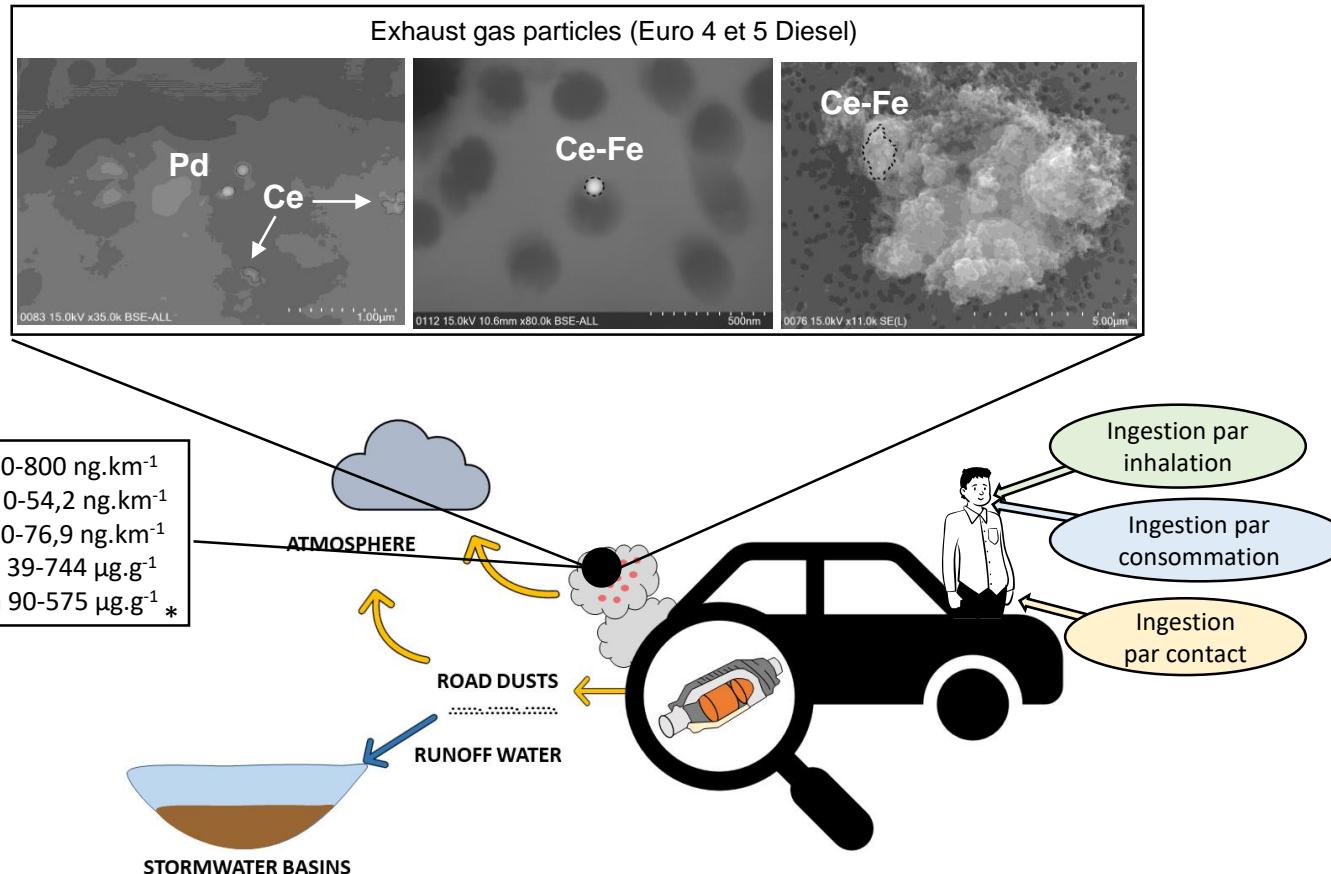
Platinum Group Elements (PGEs) and Rare Earth Elements (REEs)



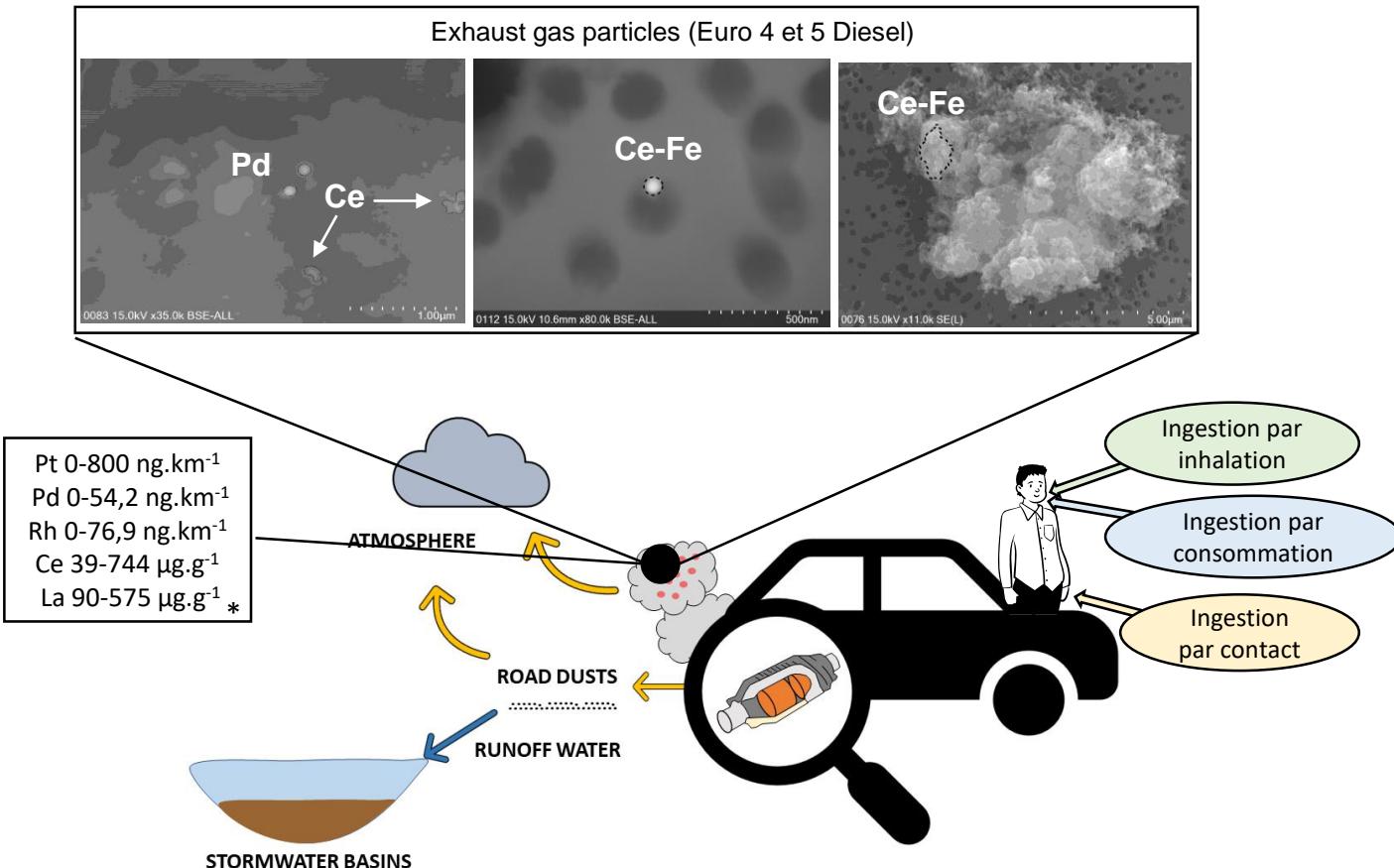
- Catalytic converters were developed in 1974 in USA and are mandatory since 1977 in USA and 1993 in Europe
- Used to reduce pollution of exhaust gas ...



... but emitted in the environment



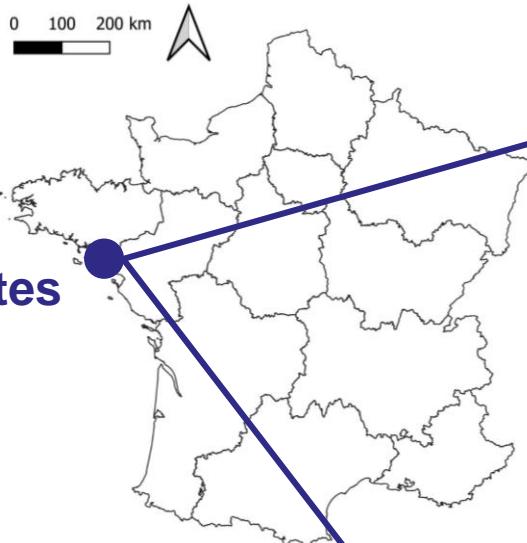
... but emitted in the environment



Objectives

1. Evaluate the **concentrations** of PGEs and REEs
2. Highlight the **contribution** of **catalytic converters emissions** and **natural sources** in PGEs and REEs concentrations
3. Determine **sizes distribution** of PGEs and REEs

Urban canyon deposit

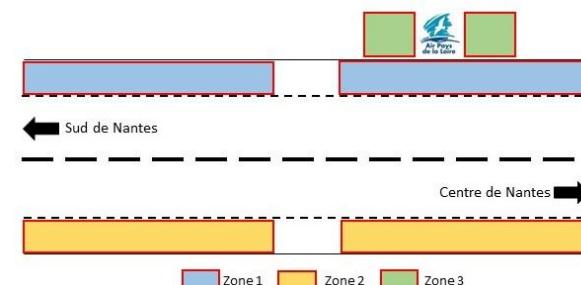


20 000 veh.d⁻¹ (Martinet et al., 2019)

30 km.h⁻¹

Sampling :

- **Winter (2017/2018)**
- **3 zones**
- **Brush and vacuum**



Preparation

1

Sieving <2mm

Granulometric fractionation by sieving



>2mm	[1 ; 2mm]
	[500 µm ; 1mm]
	[250 ; 500 µm]
	[125 ; 250 µm]
	[63 ; 125µm]
	[36 ; 63 µm]
	<36 µm

Preparation

1

Sieving <2mm

Granulometric fractionation by sieving

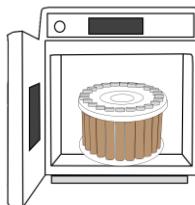


>2mm] $1 ; 2\text{ mm}$]
] $500 \mu\text{m} ; 1\text{ mm}$]
] $250 ; 500 \mu\text{m}$]
] $125 ; 250 \mu\text{m}$]
] $63 ; 125\mu\text{m}$]
] $36 ; 63 \mu\text{m}$]
	< $36 \mu\text{m}$

Analysis

2

Microwave-assisted *aqua regia* digestion
(3 HCl: 1 HNO₃, v/v) + ICP-MS analysis



Preparation

1

Sieving <2mm

Granulometric fractionation by sieving

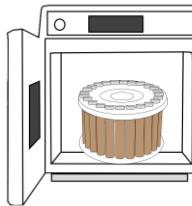


>2mm] $1 ; 2\text{ mm}$]
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Analysis

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Data processing

3

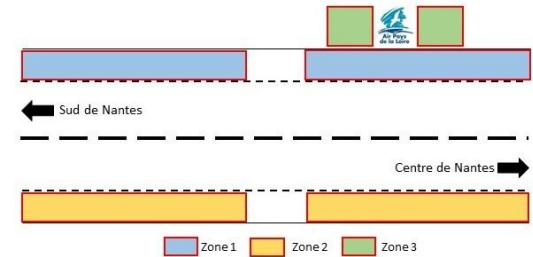
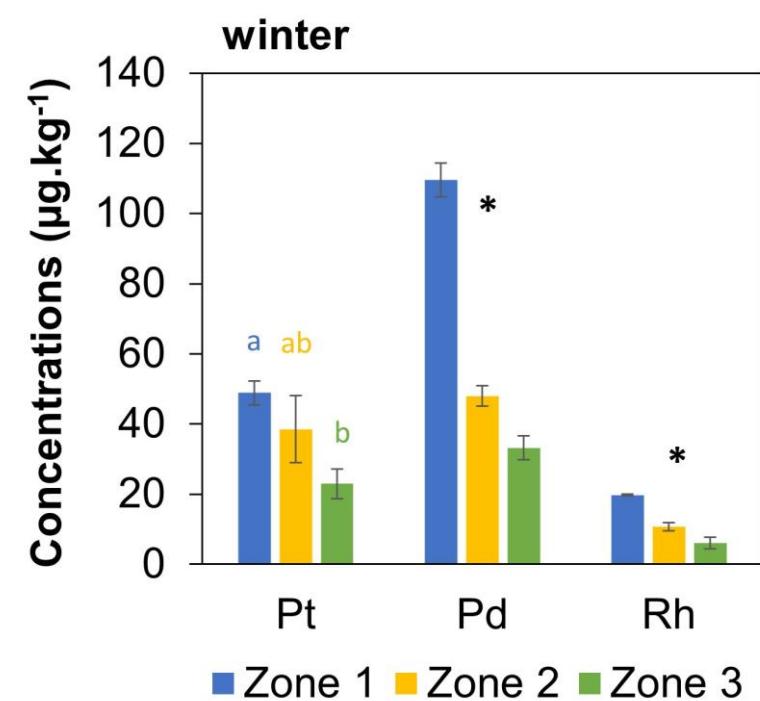
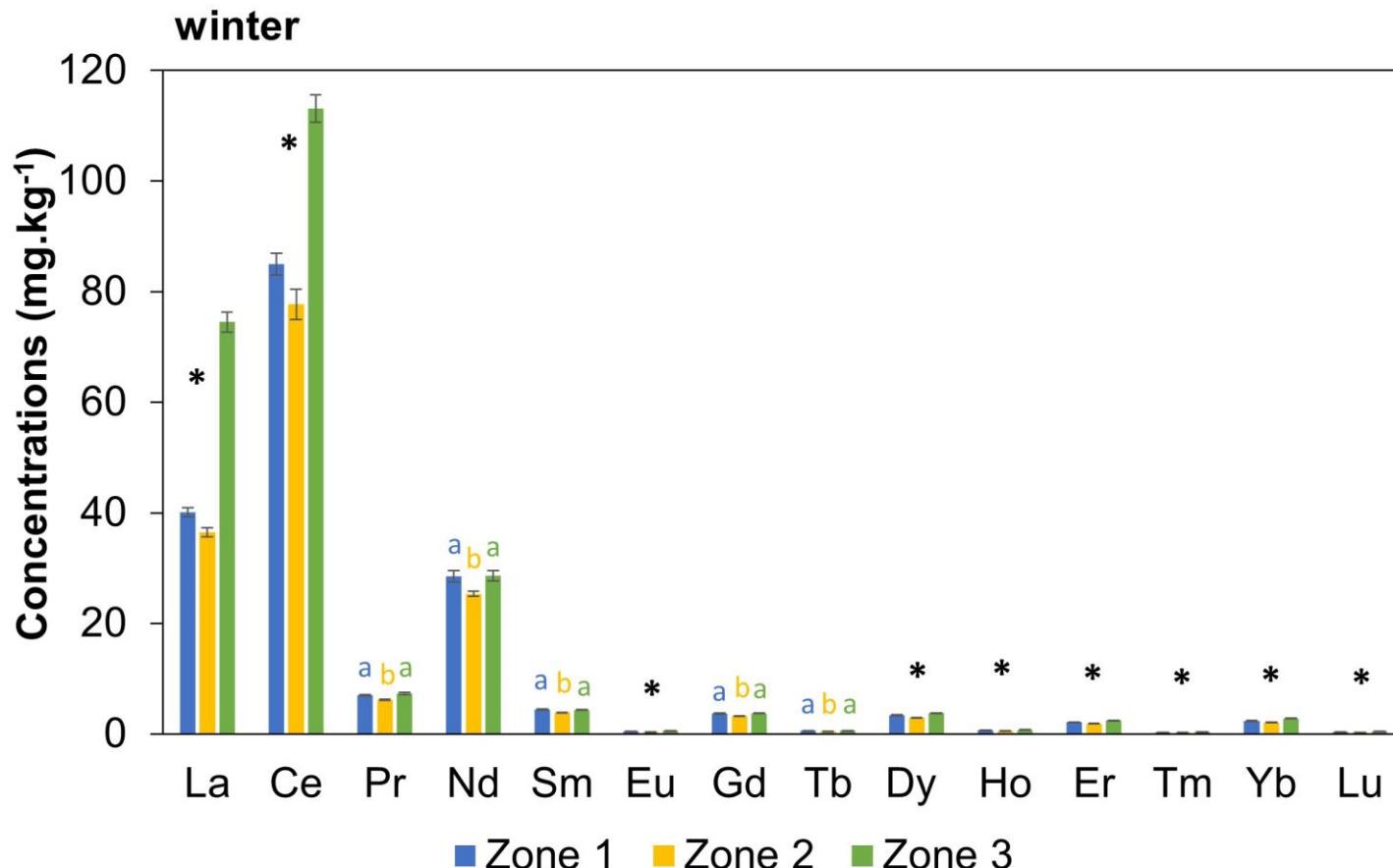
Evaluation of PGEs and REEs contaminations

- Geo-accumulation index (Igeo)
- Element ratio (La, Ce, Sm and Pt, Pd, Rh)

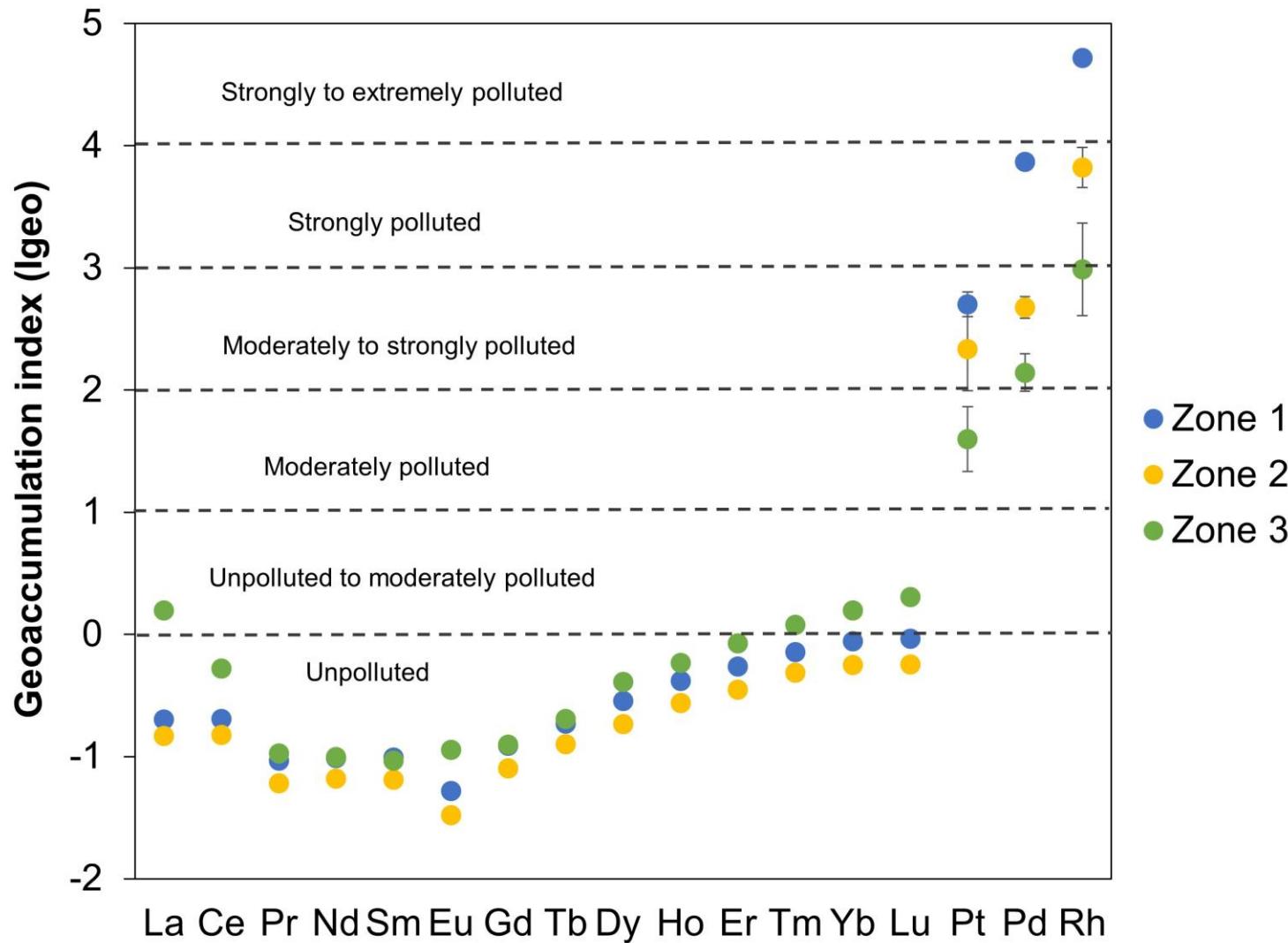
Evaluation of PGEs and REEs particles size

- Granulometric distribution

PGEs and REEs concentrations in the road dusts

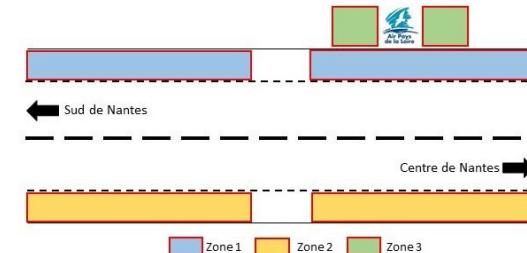


Geoaccumulation index (Igeo)

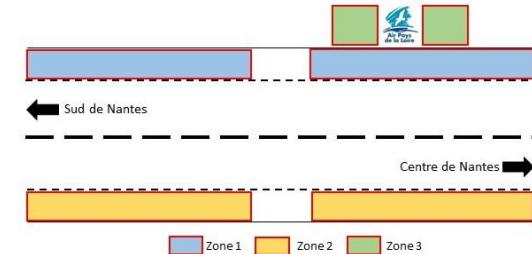
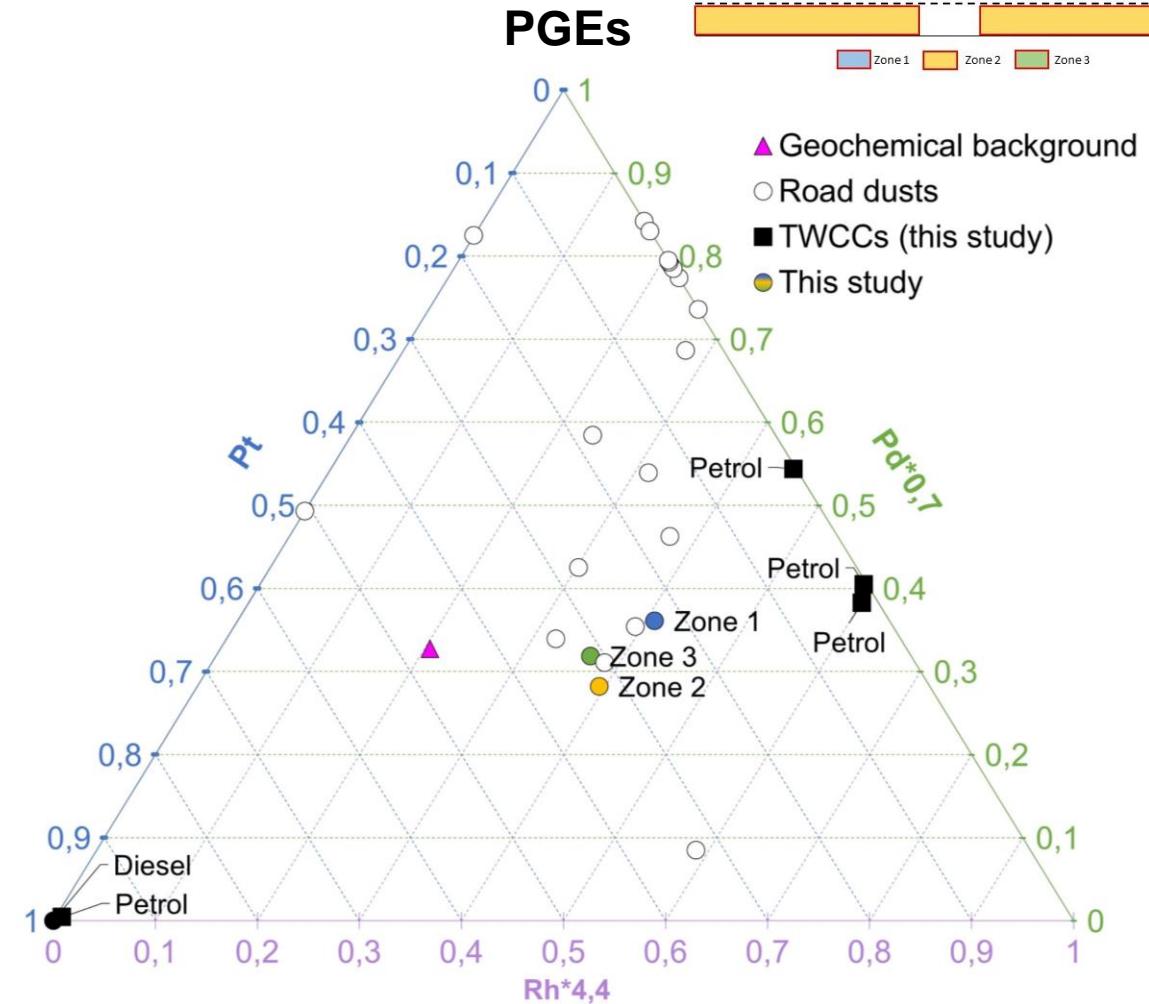
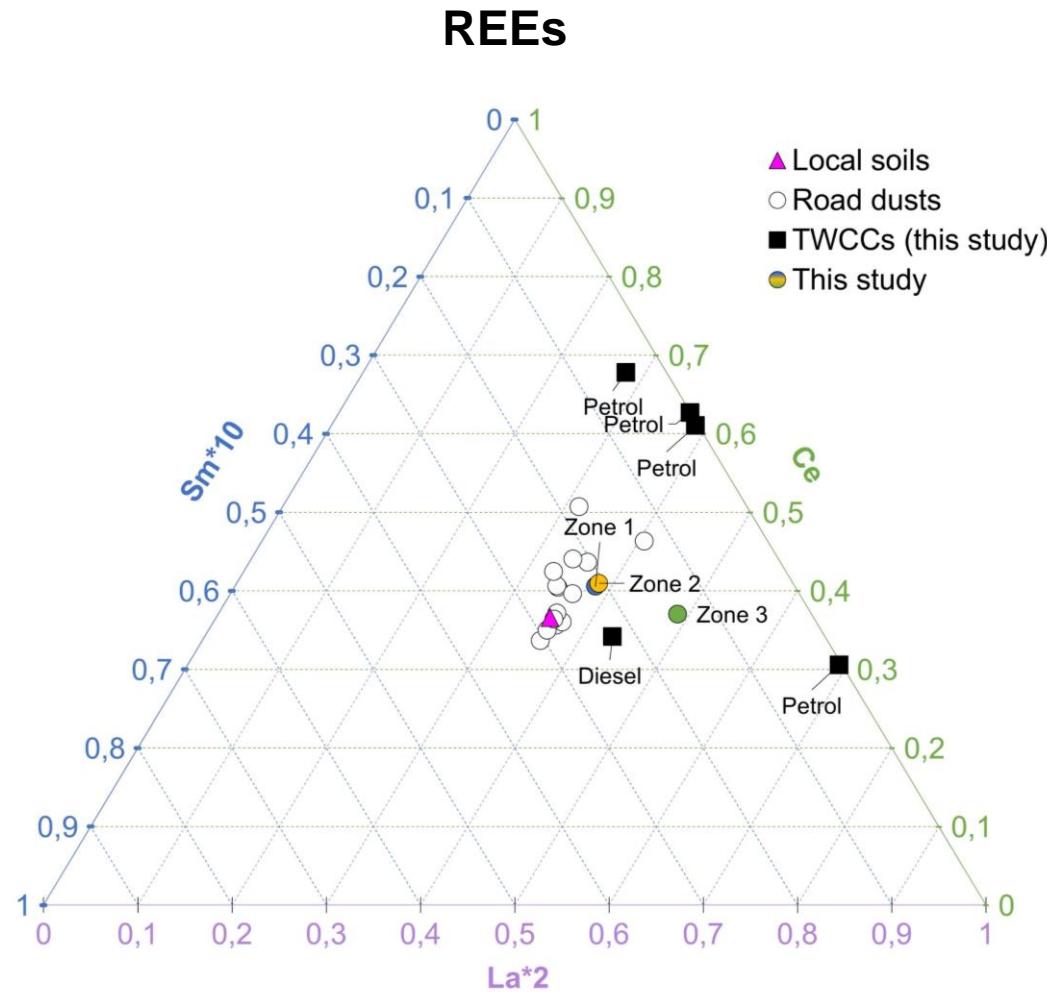


$$Igeo = \log_2\left(\frac{C_n}{1,5B_n}\right)$$

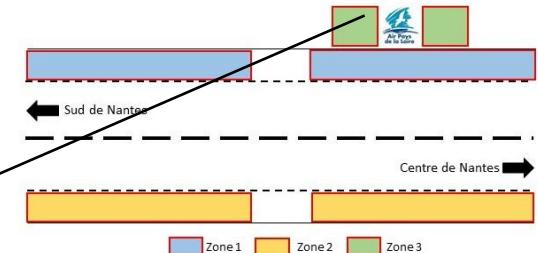
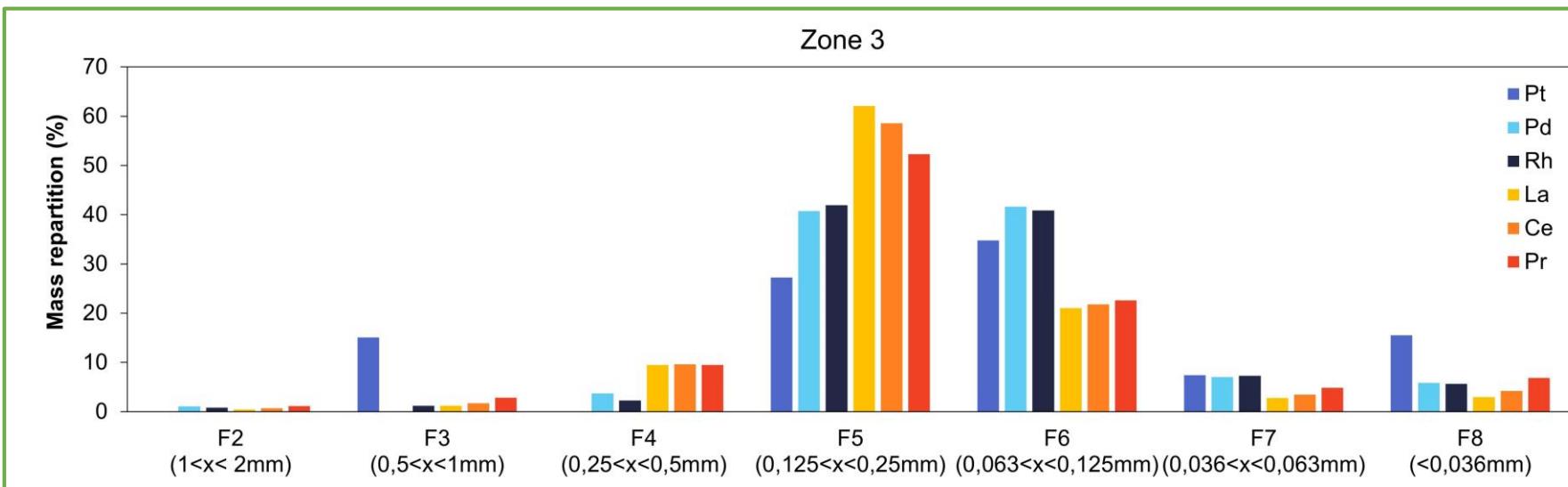
C_n = Sample concentrations of n element
 B_n = Background concentration of n element



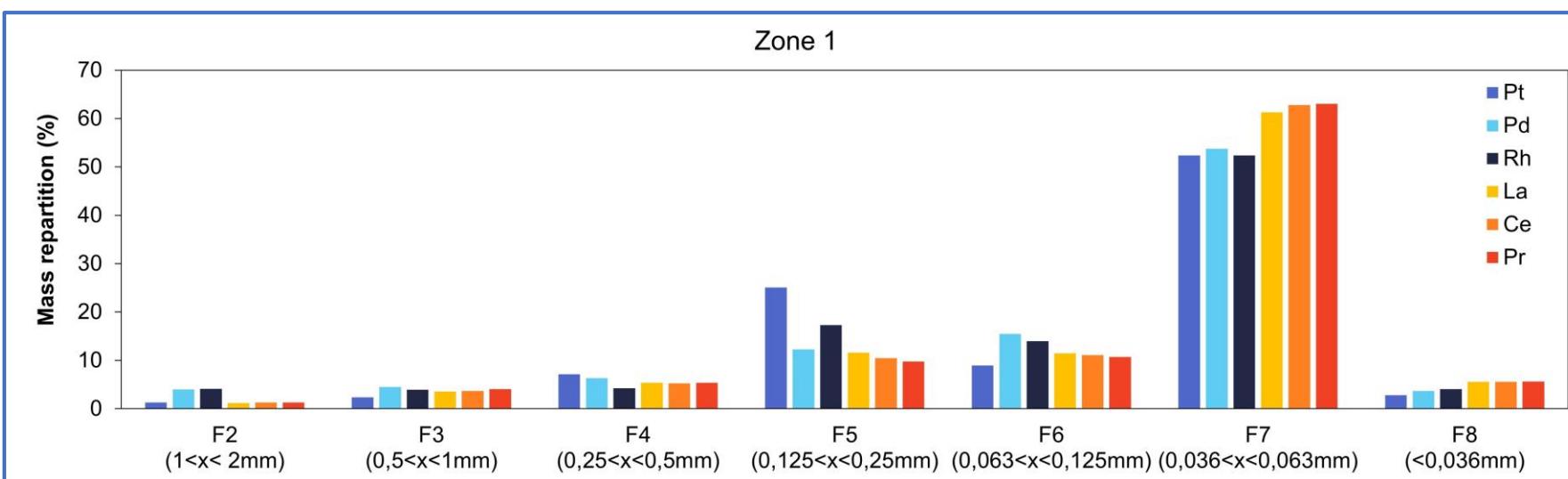
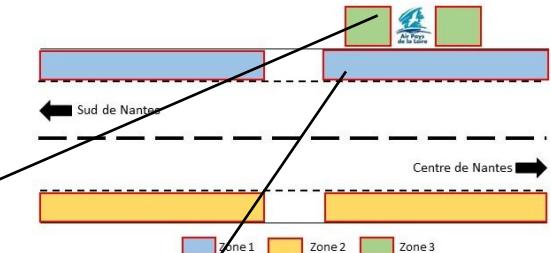
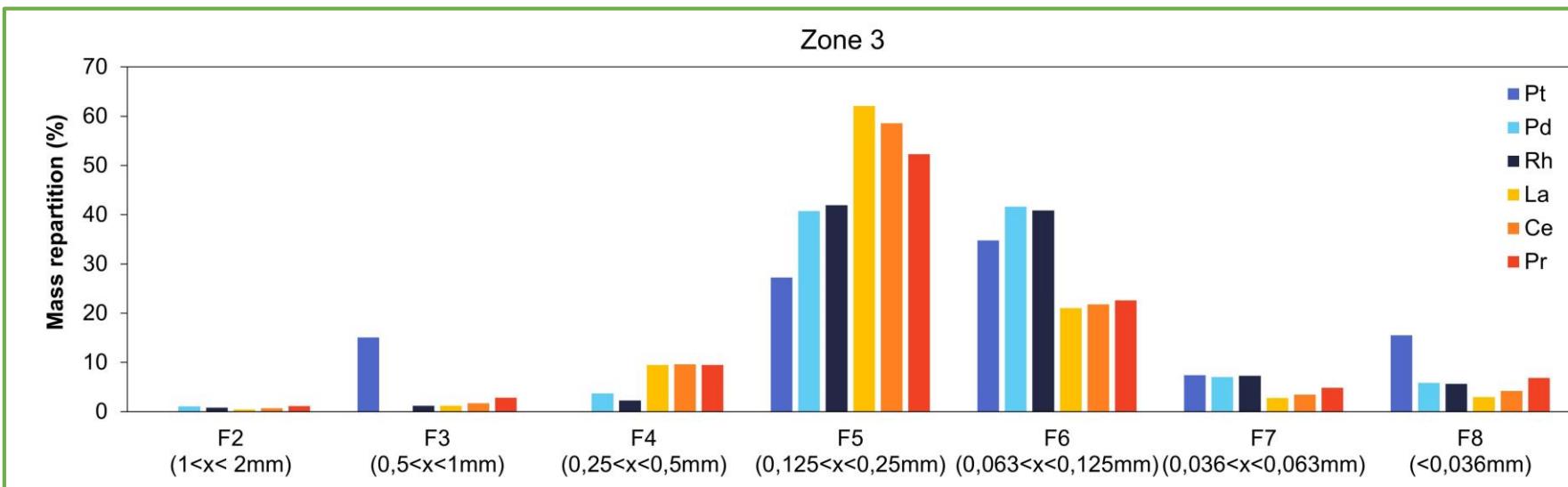
Element ratio

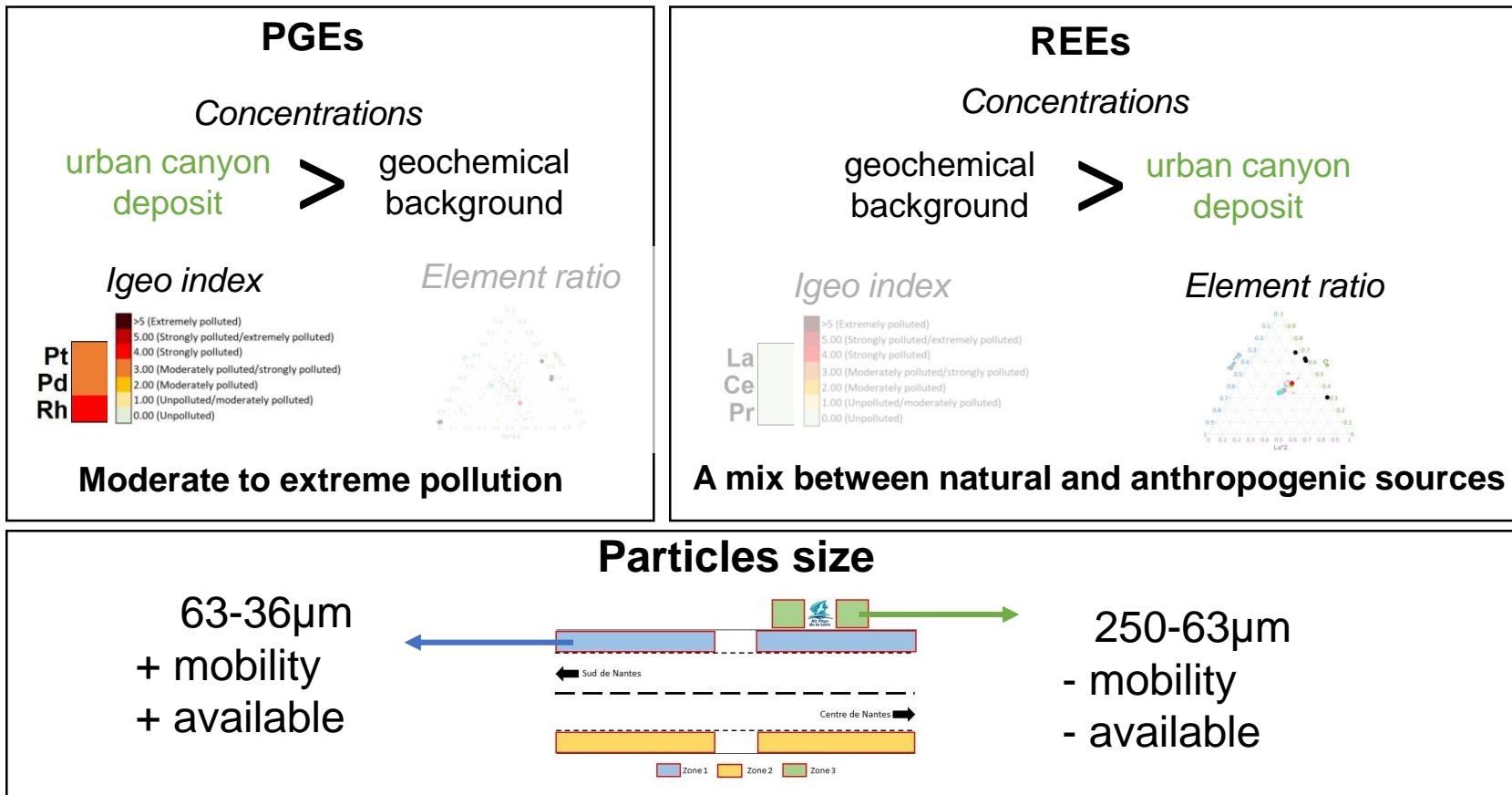


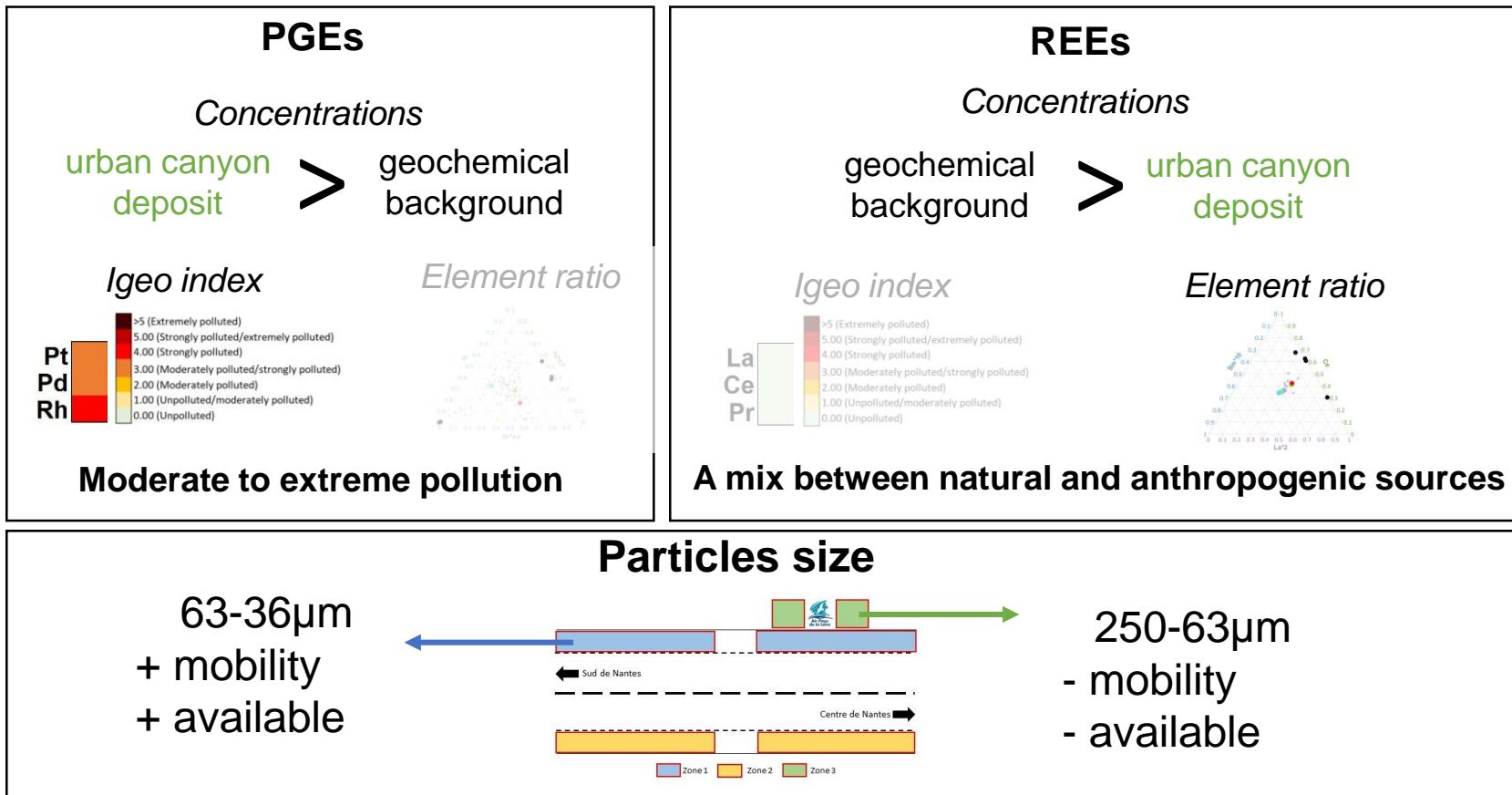
Granulometric distribution of PGEs and REEs



Granulometric distribution of PGEs and REEs







Perspectives

To discriminate natural and anthropogenic sources of REEs

- Chemical associations :

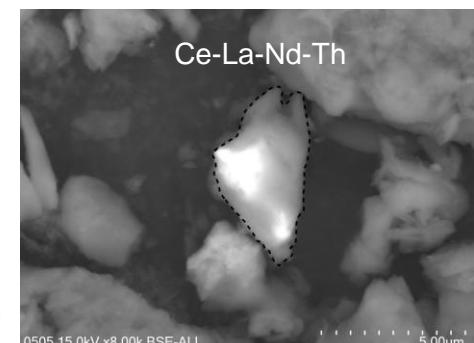
SEM-EDX observations and analysis of the road dusts

chemical elements that make up catalytic converters

REEs natural particles could be association with Th (Navarro-Ciurana et al. 2023)

Pearsons correlation or PCA between PGEs, REEs and heavy metals in the road dusts

Geochemical background



Thanks for your attention

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References

- M. **Bau**, K. Schmidt, A. Pack, V. Bendel, & D. Kraemer. 2018. 'The European Shale: An Improved Data Set for Normalisation of Rare Earth Element and Yttrium Concentrations in Environmental and Biological Samples from Europe'. *Applied Geochemistry* 90 (March):142–49. <https://doi.org/10.1016/j.apgeochem.2018.01.008>.
- DiRIF**, « L'État et la Région Île-de-France étendent la géolocalisation dans le tunnel de Nanterre-La Défense (A14/A86) », DiRIF. Consulté le: 15 avril 2023. [En ligne]. Disponible sur: <https://www.dir.ile-de-france.developpement-durable.gouv.fr/l-etat-et-la-region-ile-de-france-etendent-la-a1319.html>
- S. **Martinet**, Y. Liu, L. Jean-Soro, M. Goriaux, & M. André, "In-situ estimation of non-regulated pollutant emission factors in an urban area of Nantes, France, with fleet composition characterization ", *Transportation Research Part D: Transport and Environment*, vol. 76, p. 193-210, nov. 2019, doi: 10.1016/j.trd.2019.09.023.
- D. **Navarro-Ciurana**, M. Corbella, J. Farré-de-Pablo, I. Corral, E. Buixadera, R. Morera-Valverde & J.A. Proenza. "Rare Earth Elements' particles in road dust: A mineralogical perspective for source identification", *Atmospheric Environment*, vol. 309, p. 119927, Sep. 2023, doi: 10.1016/j.atmosenv.2023.119927.