

Response of air-pollution biomonitors under three different meteorological conditions

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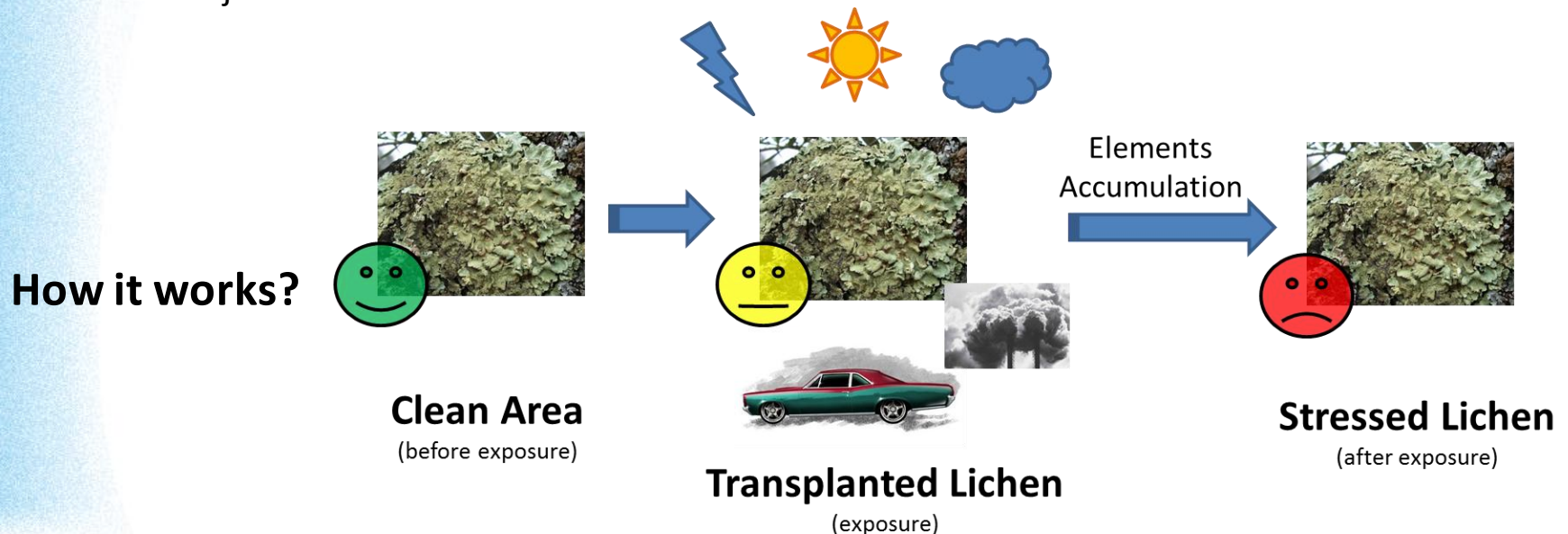


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INTRODUCTION

- The **ability of lichens** to accumulate levels of elements in excess of physiological requirements in close correlation with atmospheric elemental levels has led to their wide-scale application as **practical biomonitors of inorganic atmospheric contamination**.
- A significant **reduction in total sampling costs** and the possibility of an **intensive assessment of a certain attribute in space and time** increased the interest for this environmental monitoring tool.
- Therefore, **lichen transplants** have been routinely used in air quality biomonitoring. However, in transplant studies a certain amount of time is necessary for the lichen to adjust to the new environmental conditions.

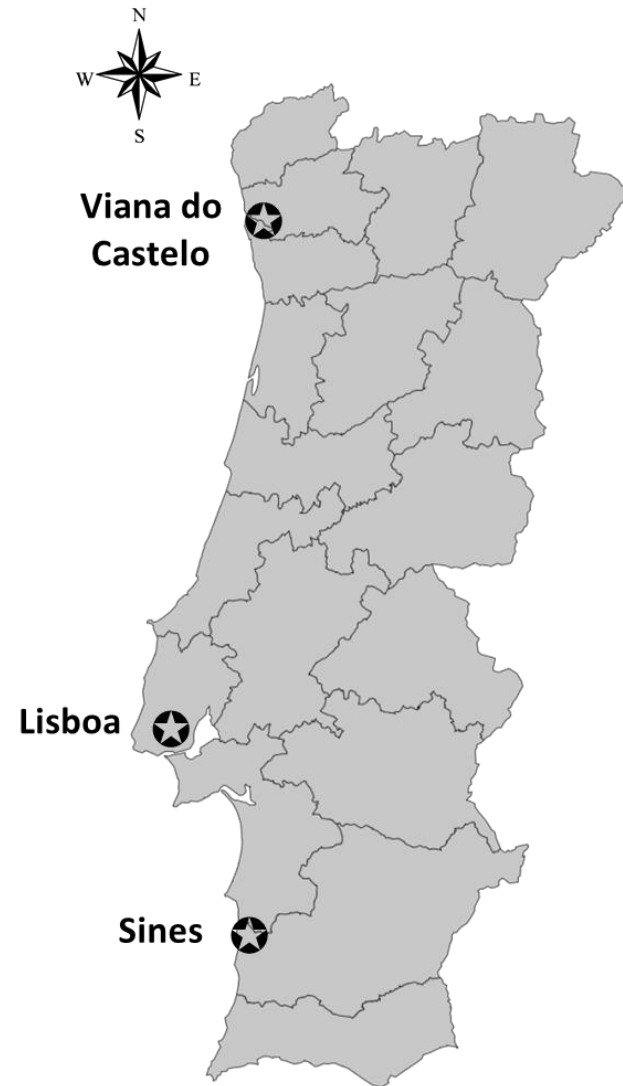


MATERIALS AND METHODS

1) Sampling Site

- Field exposure took place at the yard of 3 weather stations of the Portuguese Meteorological Network;
- The 3 sampling sites were at about 20 km to 30 km from the Atlantic Ocean.

Name	Location	Weather Conditions	Environment Type
Viana do Castelo	Northern Litoral	Wet	Low industrial
Lisboa	Central Litoral	Dry	Urban/Industrial
Sines	Southern Litoral	Drier	Industrial

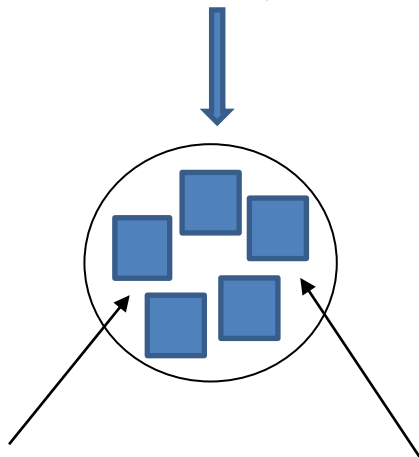


MATERIALS AND METHODS

2) Transplanted Lichens

- Samples of *Flavoparmelia caperata* thalli were collected from pine trees (*Pinus pinaster* (Ait.) Sol.) in a clean area located in a low-pollution area of northern Portugal (Baião).
- Lichen transplants done with a **well-defined exposure area** (non traditional transplant):
 - a) Lichen were detached from the bark, cleaned and washed
 - b) Lichen were cut in regular and small pieces and, then, confined into a container inside of with nylon net.

Petri slide covered with nylon net, (2 mm porosity)



Well defined exposure area of lichen pieces



MATERIALS AND METHODS

3) Total Deposition

- Atmospheric bulk deposition was collected through hanging devices into 10 dm³ buckets through 25-cm diameter funnels.

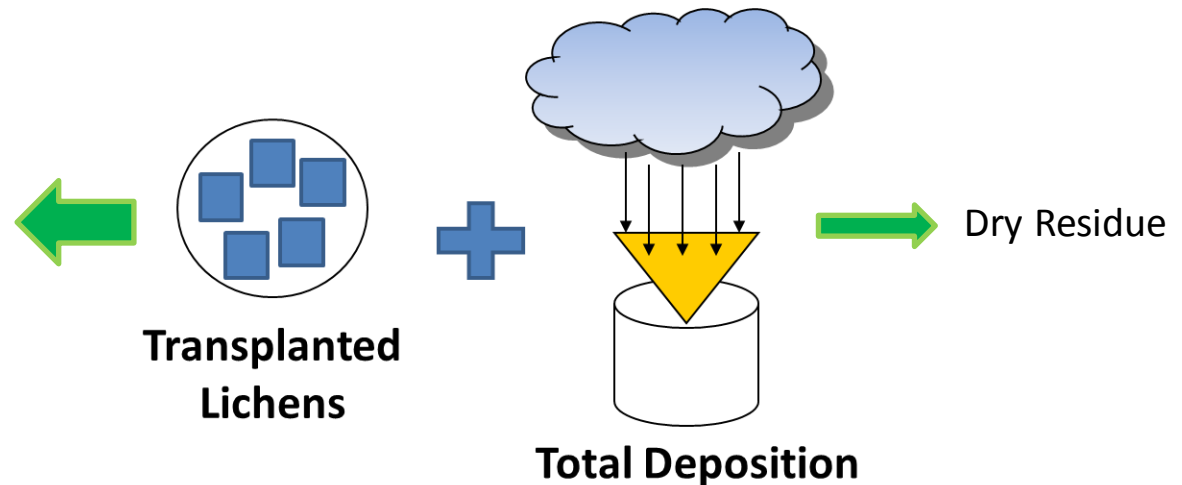
4) Timeline of the Experiment

- During periods of 2 months in a total of 10 months (from January to October).

5) Analysis



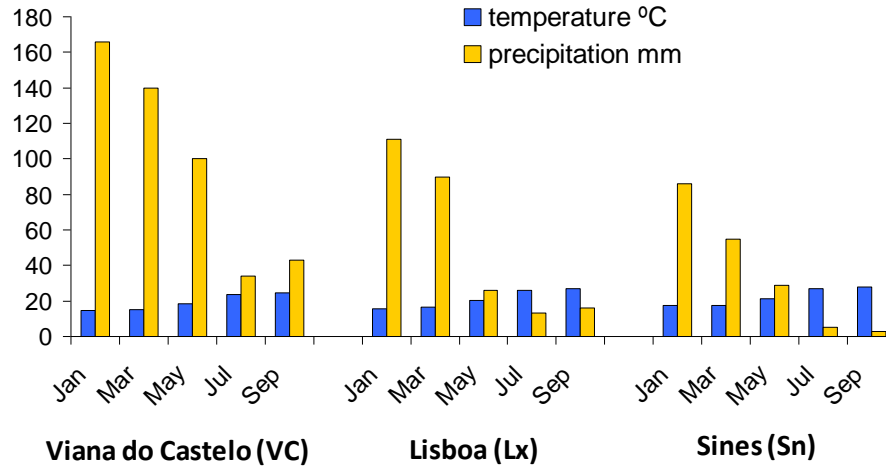
Portuguese Research Reactor (RPI)



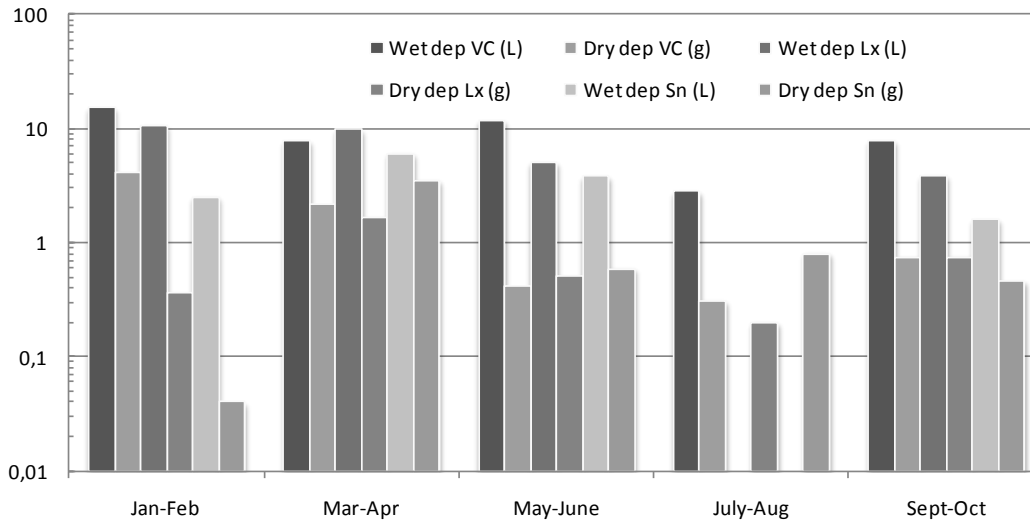
Analysis by INAA- k0 based

Analysis by ICP-MS

RESULTS



Meteorological Data



Wet and Dry Deposition

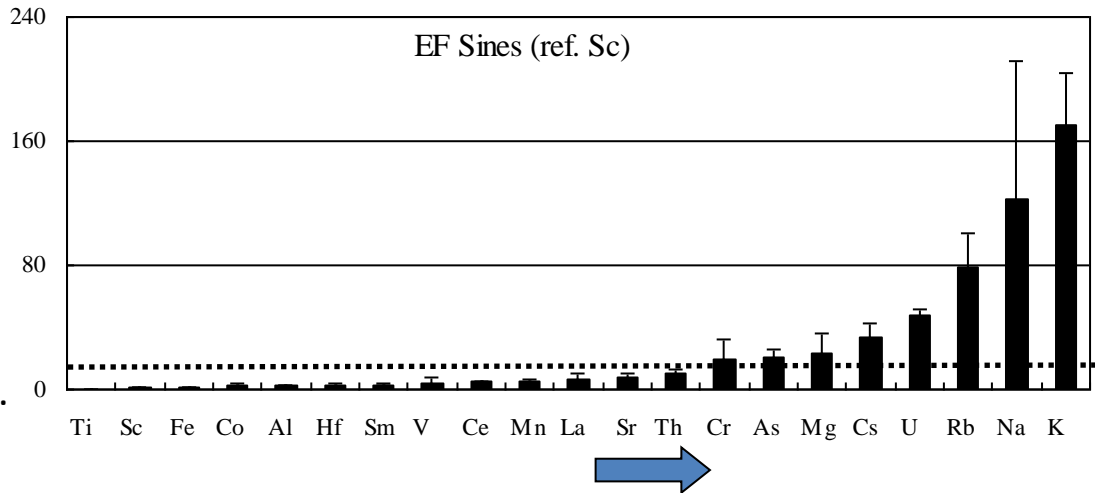
RESULTS

Enrichment Factors

$$EF_X = \left\{ \frac{[X]}{[Sc]} \right\}_{\text{Dep., Lichen}} / \left\{ \frac{[X]}{[Sc]} \right\}_{\text{Soil}}$$

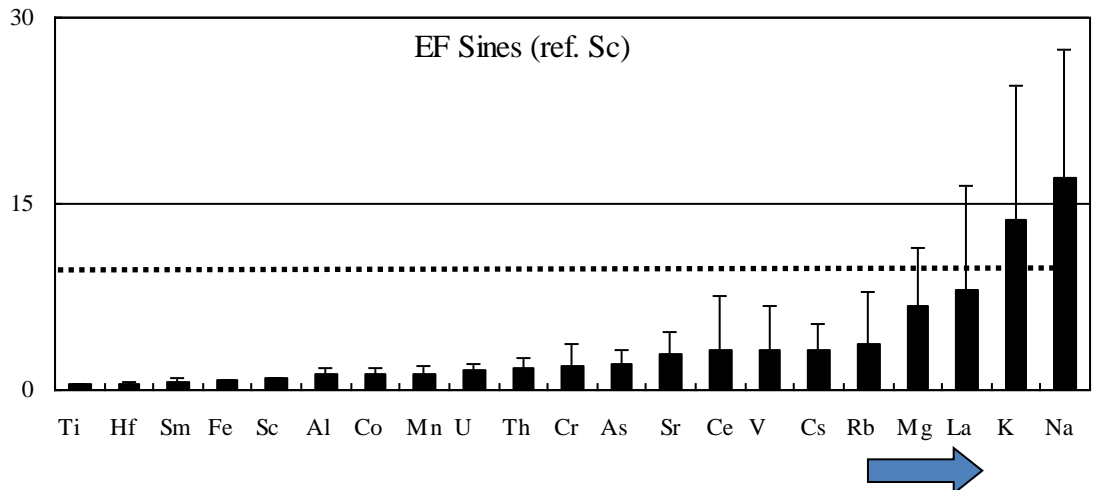
Transplanted Lichen

Reflects other sources than soil:
Marine source
Physiological component
Industrial component
 (coal power plant, most probably).



Bulk Deposition

Reflects marine source only.
 Soil is most probably polluted too.



RESULTS

Pearson's Correlation

Viana do Castelo (VC)

Bulk Deposition

	Mass	As	Ce	Co	Cr	Cs	Cu	Fe	K	Mg	Mn	Ni	Sc	Sr	Th	Zn
Mass	1.00	0.91	0.90	0.80	0.99	0.78	0.59	0.77	0.98	0.99	0.76	0.92	0.78	1.00	0.75	0.86
Cr	0.98	0.96	0.96	0.88	0.95	0.86	0.71	0.86	0.99	0.95	0.85	0.96	0.88	0.97	0.85	0.93
K	-0.92	-1.00	-0.99	-0.97	-0.87	-0.96	-0.86	-0.95	-0.96	-0.86	-0.95	-0.99	-0.95	-0.89	-0.95	-0.99
Mg	-0.64	-0.89	-0.89	-0.97	-0.57	-0.98	-0.99	-0.97	-0.71	-0.54	-0.98	-0.88	-0.94	-0.59	-0.98	-0.94
Mn	-0.86	-0.98	-0.96	-0.98	-0.82	-0.97	-0.88	-0.94	-0.92	-0.80	-0.96	-0.97	-0.92	-0.83	-0.94	-0.99

Mass – mass of the dry residue

Transplanted Lichens

- **Higher number of correlations** between elements in transplanted lichens and bulk deposition in **Viana do Castelo** (above).
- Lisboa (Ln) also showed significant correlations of transplanted lichens for **Fe** and **Sc** (with rainwater volume) and for **Pb** (with mass of the residue).

DISCUSSION & CONCLUSIONS

- ❖ The highest number of significant associations was found in the **northern site**, which most probably is related to **higher availability of humid air of the area**.
- ❖ the biological signals of detached lichens are compatible with sources in the area
- ❖ there is an appreciable number of airborne elements significantly enriched in (exposed) lichen samples, including some of great environmental interest
- ❖ the cumulative contents per unit area of detached-lichen material are likely to provide an acceptable estimate of the atmospheric availability of enriched elements, as measured by their cumulative contents in the dry residues of bulk deposition.

ACKNOWLEDGEMENTS

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