PARTICLE POLLUTION AND THE ROLE OF ECOLOGICAL INDICATORS FOR THE PREVENTIVE CONSERVATION OF CULTURAL HERITAGE

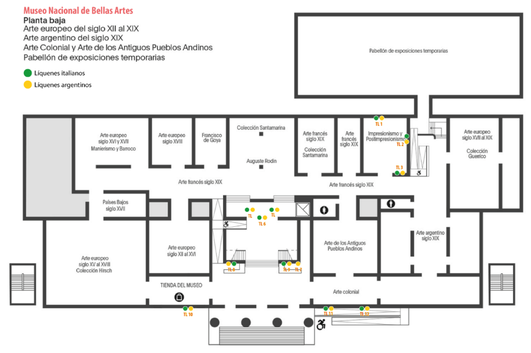
Marcos A.E. Chaparro[a] (chapator@exa.unicen.edu.ar); Débora C. Marié[a], Daniela Buitrago Posada[a], Aldo Winkler[b], Marcos Tascon[c], Lisa Grifoni[b,d], Martina Scoccimarro[c], Federico Cherny[c], Fernando Marte[c], L. Pensabene Buemi[e], Francesca Boldrighini[f], A. Russo[f], Gabriella Strano[f], Luigi A. Di Lella[d], Lilla Spagnuolo[b], Stefano Loppi[d], y Antonio Sgamellotti[g]

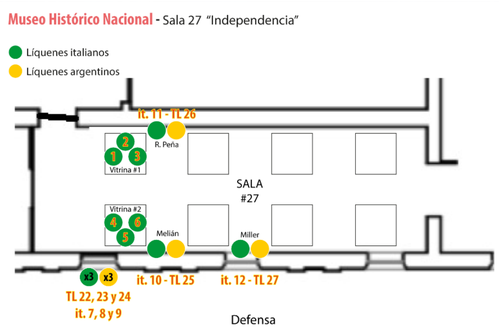
[a]Centro de Investigaciones en Física e Ingeniería del Centro de la Provincia de Buenos Aires, UNCPBA-CICPBA-CONICET, ARGENTINA; [b]Istituto Nazionale di Geofisica e Vulcanologia, ITALIA; [c]Centro de Estudios sobre Patrimonios y Ambiente, UNSAM, ARGENTINA; [d]Department of Life Sciences, University of Siena, ITALIA; [e]Peggy Guggenheim Collection, Venice, ITALIA; [f]Parco Archeologico del Colosseo, Roma, ITALIA; [g]Accademia dei Lincei, Roma, ITALIA

Anthropogenic particle pollution is an increasing concern in urban contexts because it may adversely influence citizens' cultural heritage (CH), such as museums, archaeological sites, and historic buildings. Among adverse consequences of particulate matter (PM) on CH institutions, it may act on the surfaces, creating dark layers, abrasion of materials, depletion, discoloration, and consequent artistic loss. The latter has recently been studied using magnetic biomonitoring (MB) in various Italian institutions and urban archaeological sites, including Villa Farnesina in Rome, the Peggy Guggenheim Collection in Venice, and the Palatino Hill of Parco Archeologico del Colosseo. We present here the first magnetic biomonitoring study in Argentina focused on the preventive conservation of the collections preserved at the Museo Nacional de Bellas Artes (MNBA) and the Museo Histórico Nacional (MHN) in Buenos Aires. *Keywords:* Cultural Heritage, Lichen, Magnetic Biomonitoring, PM, Urban trees

Preventive conservation of Cultural Heritage

National museums: MNBA and MHN

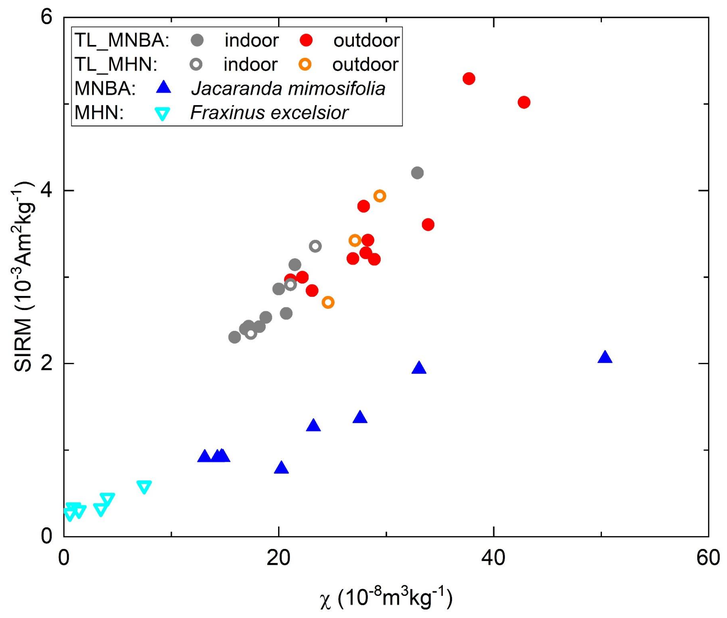




Methods

Thalli of lichen species (*Parmotrema pilosum*) were collected at remote sites and transplanted to indoor and outdoor sites for three months. In addition, for biomonitoring purposes, leaves from urban trees (*Jacaranda mimosifolia* and *Fraxinus excelsior*) were collected at increasing distances from MNBA and MHN, respectively. The magnetic properties of lichens and leaves were determined *in situ* and in the laboratory of Environmental Magnetism at the CIFICEN (Argentina) through the following measurements: magnetic susceptibility, anhysteretic, and isothermal remanent magnetization (IRM).

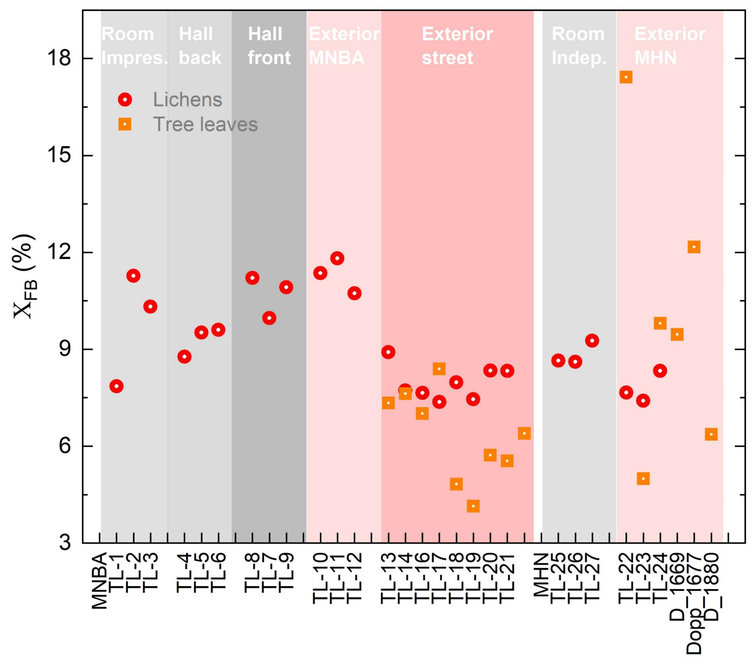
Results



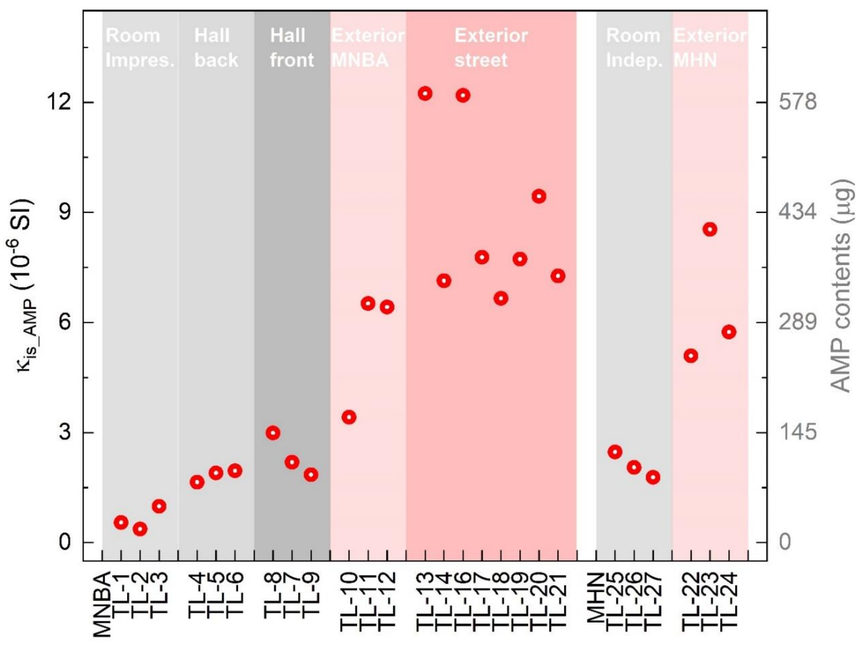
Higher values of mass-specific magnetic susceptibility χ and saturation IRM (SIRM) were obtained for tree leaves of *J. mimosifolia* (e.g., χ = 13.1-50.4 $\times 10^{-8} m^3 kg^{-1}$) than *F. excelsior* (e.g., χ = 0.6-7.5 $\times 10^{-8} m^3 kg^{-1}$). Further magnetic analyses are ongoing on *Evernia prunastri* lichen transplants. Elemental analysis of lichens and leaves (in progress) will give complementary information regarding the origin and impact of the pollution.

Results

Percentage frequency-dependent magnetic susceptibility ($X_{FB(1,16)}$) measured for lichen transplants and collected leaves evidenced (sub-)micron-sized superparamagnetic particles for lichen transplants (mean and [s.d.] values of $X_{FB(1,16)}$ = 8.3 [1.4]%) and for leaves ($X_{FB(1,16)}$ = 7.8 [3.4]%).



Lichen transplants evidenced lower magnetic concentration and finer trapped airborne magnetic particles (AMP) for indoor (AMP content = 20-140 µg) than outdoor (AMP content = 160-590 µg) sites, where magnetite-like minerals dominate (remanent coercivity H_{cr} = 34.3-37.7 mT).



Conclusions

– Magnetic biomonitoring makes it possible to evaluate pollution by (sub-)micron-sized magnetic particles AMP in specific periods and CH sites of interest. The in situ MB quantify accumulated AMPs in transplanted lichens (*P. pilosum*), which evidenced a lower concentration of AMPs for indoor (museum rooms) than outdoor sites.

– Among urban trees, higher values of concentration-dependent magnetic parameters were obtained for leaves of *J. mimosifolia* than *F. excelsior*. Although both species trapped AMPs, *J. mimosifolia* seems a more effective AMP collector for CH sites.

– The characterization and quantification of AMP provide vital information for the preventive conservation of Cultural Heritage in urban environments.