Assessing the impact of vehicular particulate matter on cultural heritage by magnetic biomonitoring: Villa Farnesina and Palatine Hill in Rome, Italy

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Cultural heritage is heavily threatened by air pollution: particulate matter acts on the surfaces, often resulting in irreversible damage to the operas.
Magnetic biomonitoring methodologies were applied at Villa Farnesina, Rome, with loggias frescoed by renowned artists such as Raffaello Sanzio. Plant leaves and lichen transplants were respectively sampled and exposed at increasing distances from the main trafficked road, introducing an outdoor vs. indoor mixed sampling design for outlining the impact of vehicular particulate matter on the Villa Loggias.
The magnetic properties of leaves and lichens showed that the bioaccumulation of magnetite-like particles, mainly linked to vehicle brake emissions, decreased exponentially with the distance from the road. The frescoed halls were preserved from important inputs of metallic PM, due to the combined effect of the distance from the road and the ecosystem preventive services provided by tree and shrub leaves, intercepting vehicular PM.
A similar approach is currently adopted at the Palatine Hill of Parco Archeologico del Colosseo, where different species of trees and plants were recently sampled for outlining the most suitable for providing protective ecosystem services when cultural heritage is inserted in complex urban areas.