MAGNETIC CHARACTERIZATION OF NATURAL AND ANTHROPOGENIC ATMOSPHERIC DEPOSITION OVER SOUTHWESTERN EUROPE; RESULTS FROM THE DONAIRE NETWORK

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We present an environmental magnetic study of atmospheric deposition collected in the framework of DONAIRE, a network deployed in Spain between June 2016 and June 2017 to characterize atmospheric deposition at fourteen locations representative of urban, industrial, agricultural, and natural environments across southwestern Europe. A combination of rock magnetic methods with scanning electron microscopy and geochemical data has enabled us to characterize the magnetic mineral assemblages of particulate matter across different types of sites and phenomenological scenarios, and to unravel their environmental significance in terms of the most important anthropogenic and natural components of atmospheric deposition. Our results indicate the presence of two magnetite/maghemite components of anthropogenic origin, derived mostly from vehicular traffic, plus a hematite component associated with a baseline supply of north African dust, in all the studied sites regardless of their type. The ubiquitous presence of anthropogenic magnetite/maghemite particles in pristine natural environments, although in lower concentrations, point to their arrival from neighbouring urban areas through atmospheric mixing processes. Particulate matter deposited during distinctively intense periods of north African dust supply are characterized by a fourth component, represented also by coarser-grained hematite, that is likely derived from a different source area within the Sahara Desert. The simultaneous increase observed in these cases in the amounts of magnetite/maghemite particles suggests strongly that part of the magnetite/maghemite load attributed to anthropogenic sources for the rest of the phenomenological scenarios is aeolian in origin. This seems to explain the overall moderate correlation observed between magnetite/maghemite contents and geochemical proxies for vehicular traffic (Cu and Sb), and demonstrates the need for caution when interpreting environmental magnetic proxies for magnetite/maghemite abundances in terms of anthropogenic loads. This is especially important in the case of southern European cities, where a steady supply of north African dust occurs throughout most of the year. Our results show a good correlation between hematite abundances and geochemical proxies for north African dust (Ti, Al), which collectively delineate broad maxima during the summer and large peaks during distinctive dust breakouts. Environmental magnetic proxies of hematite abundances can be confidently used to monitor the contribution of north African dust to atmospheric deposition.

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