Hazardous thoracic and ultrafine particles from road dust in a Caribbean industrial city

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Abstract

In this study, inorganic geochemical characterization of the thoracic (or < 10 μm) fraction of road dust in Barranquilla (a major industrial city in the Caribbean region) was conducted. Samples were collected directly from street pavements, and the fraction of particles <10 μm was analyzed by inductively coupled plasma - optical emission spectroscopy (ICP-OES) and inductively coupled plasma - mass spectrometry (ICP-MS). Major elements including Al, Ca, Fe, K, Mg, Na, and S were the most abundant species, accounting for 23 ± 18% of the mass of thoracic particles. Enrichment factor was calculated obtaining that Sb, Sn, Cu, Zn, Pb, and Fe had a dominant anthropogenic influence. An exploratory analysis of morphology and geochemical composition of ultrafine particles was conducted using a field emission scanning electron microscope (FE-SEM) and high-resolution transmission electron microscope (HR-TEM). Iron particles were identified as enriched compounds and as a mineral (magnetite). Hazardous ultrafine particles (UFPs, with diameter < 100 nm) such as TiO2 and Pb (agglomerated shape), and V and Ni (almost-spherical carbonaceous particles) were also detected. The braking process was identified as a crucial urban source of thoracic particles and UFPs. The results provide data that can be used to better understand and manage road dust.

Keywords

PM_{10}; Hazardous materials; Barranquilla, Nanoparticles; Dust resuspension; Traffic-related emissions