Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19740

Shedding Light on the Source of Rare Earth Elements' Particles in Road Dust

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Ambient particulate matter (PM), which is breathed and may accumulate on urban roads, is a serious pollution issue and one of our society challenges. Road dust is constituted by different fractions of geogenic and anthropogenic particles, which commonly act as a toxic PM storage. Although some research provide evidences that Rare Earth Elements (REEs) on urban dust, particularly Ce and La, are anthropogenically sourced from automotive three-way catalytic converters (TWCC: Meza-Figueroa et al., 2021), there is still a strong uncertainty about their potential geogenic origin (Dehghani et al., 2018). This ambiguity is partially related to the fact that environmental studies on road dust are routinely focused on the REEs chemical bulk contents overlooking the mineralogical features of particles. This work characterizes for first time the occurrence of REE particles in roadside dust in the Barcelona area, by means of mineralogical studies, identifying their sources and understanding their accumulation. The investigated REE particles, with Ce ±La-Nd, are spheroidal, rounded, elongated and angular in shape (< 5 μm), often forming nanoparticle aggregates. The identical morphologies and chemical characteristics independently from the sampling location, even with different geological surroundings, points to a unique anthropogenic origin. The absence of U and Th contents in REE particles are characteristics of anthropogenic ceria (CeO_2) broadly used as metastable solid solution with zirconia ($CeZrO_x$) in autocatalytic converters. CeO_2 particles are not enriched in Zr, and zirconia crystals also found in the dust do not show Ce traces. This might indicate that they were released as separated neo-formed CeO_2 phases, which is consistent with a metastable $CeZrO_x$ segregation at the autocatalyzer operation conditions from automobile engines. The inhalable ceria particles emitted by vehicles are a significant environmental health hazard, revealing the need for further investigation and assessment of CeO_2 levels generated by automobiles in urban areas worldwide.

References:

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