Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15270

Is zirconium a good marker of traffic-related pollution?

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Traffic-related pollution deteriorates air quality and adversely affects human health, especially in large cities with a dense road network. Hence, an increasing interest has recently been observed in studies of chemical markers of traffic-related pollution in road dust samples. Zirconium is one of the trace elements which can easily be determined in solid samples by an X-ray fluorescence (XRF) technique. Zirconium silicate ($ZrSiO_4$) is an abrasive material used in brake pads, whereas zirconium oxide (ZrO_2) with an admixture of cerium oxide (ceria-zirconia) is employed in three-way catalytic converters. Thus, potential sources of Zr in the road dust include wearing of the brake pads and emissions from catalytic converters. However, results of studies reporting Zr concentrations in road dust are inconclusive in terms of Zr source.

In this study we measured Zr concentrations in the road dust samples collected from three roads with different traffic densities in the city of Kielce, south-central Poland. Concentrations of Zr in <2.00 mm grain size samples ranged from 25 to 115 mg/kg (n=26). This study encompassed not only bulk chemical analyses by ED-XRF, but also optical microscopy observations and SEM-EDS and EMPA analyses of road dust, river sediments and roadside soils samples. The results show that zircon ($ZrSiO_4$) is a common mineral in all samples. It originates from weathering and erosion of the local bedrock or is an inherent part of quartz sand used with salts for winter road maintenance. No zirconia (ZrO_2) grains have been traceable in the examined samples. Zirconium in bulk road dust samples, cannot be used as a tracer of traffic impact on the environment due to the widespread occurrence of disintegrated lithogenic zircon grains. For this reason, it is impossible to discriminate natural tiny zircon splinters from their anthropogenic equivalents derived from traffic-related pollution.

This study was financially supported by the National Science Center of Poland (research grant #2019/35/B/ST10/00821).