

Platinum Group Elements in Indian Environment: Magnitude and Pathways

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Human displacement of platinum group elements (PGE) includes platinum (Pt), palladium (Pd) and rhodium (Rh) on the Earth's surface are significantly higher than those derived from natural sources [1]. As a result, biogeochemical cycling of Pt, Pd, and Rh are perturbed by human activities. Here we report the magnitude and transportation pathways of PGE in India. To better understand magnitude and transportation pathways of PGE, road dust and atmospheric particulate matters were collected from a industrial site, a megacity and a pristine site in northern India. Briefly, road dust and airborne particulate matters (≤ 10 -micron sized atmospheric particulate matter~PM₁₀) were collected from Harsil (31.03°N, 78.74°E), a pristine location on the Himalayan mountain range. In addition, samples were collected from Kanpur (26.45°N, 80.33°E) and Delhi (28.70°N, 77.10°E), which can be considered as industrial city and mega city, respectively. Samples were analysed following a newly developed analytical protocol designed for environmental purpose. The protocol includes measurements using inductively coupled plasma-tandem mass spectrometry (ICP-MS/MS, also known as ICP- QQQ-MS) with 10% NH₃ in He as reactive gas in Collision/Reaction Cell following sample digestion using a High-Pressure Asher (HPA-S, Anton Paar) in combination with isotope dilution (ID) as a calibration strategy, complex matrix separation using cation exchange resin. Platinum ($^{198}\text{Pt} \rightarrow ^{198}\text{Pt}$) and Pd ($^{106}\text{Pd} \rightarrow ^{106}\text{Pd}$) were measured on-mass, whereas Rh was measured both on mass ($^{103}\text{Rh} \rightarrow ^{103}\text{Rh}$) and with mass shift ($^{103}\text{Rh} \rightarrow ^{171}[\text{Rh}(\text{NH}_3)_4]^+$). The method was validated with road dust (BCR-723, European Commission's Joint Research Centre (JRC) in Geel, Belgium) and ultramafic komatiite (OKUM, IAGeo Limited).

Our results reveals a positive correlation between the PGE concentrations and traffic density, as well the most pristine sites around Harshil had $78\% \pm 5\%$ of the proportion from anthropogenic sources. We conclude that anthropogenic PGE particles are ubiquitous in Indian environment, including the high altitude Himalayan sites.

References: [1] Mitra & Sen, GCA, 2017, 417-432