Impact of vehicle-emitted platinum group elements on the human respiratory and digestive tracts

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Introduction

The use of platinum group elements (PGEs) in vehicle exhaust catalyst (VECs) represents a source of highly dispersed environmental contamination and these metals have been identified in a variety of airborne samples, dusts, soils and waters. The VEC-emitted PGEs can interact with several ligands in the environment and be transformed into soluble species that can enter the food chain with potential environmental and health risks. In order to evaluate the potential pathways of PGEs from VECs into humans, physiologically based tests were used to study the uptake of PGEs by the human respiratory and digestive tracts.

Method

The tests were used to provide quantitative data on the bioavailability of PGEs from road dust, powdered exhaust catalyst and metal hydroxide samples. The digestive assay was implemented in two phases, simulating the passage of ingested dust from the acidic environment of the stomach to the near neutral conditions of the small intestine. The respiratory tests employed various simulated lung fluids. All the extracted samples were analyzed for PGE content by inductively coupled plasma mass spectrometry.

Discussion and conclusions

The results show that PGEs in road dust samples provide the greatest fractions of bioavailable PGEs (up to 87%), probably due to transformation into soluble and mobile species through complexation by ligands common in the roadside environment. The highest PGE releases were observed in lung solutions analogous to the fluid with which inhaled particles would come into contact after phagocytosis by cells.

A high % of PGEs from VEC-emissions (i.e. road dust) is dissolved in the respiratory and digestive tracts. From the toxicological perspective, it is important to consider the possible formation of PGE-chloride complexes due to the presence of Cl ions in the stomach and lung environments, perhaps with increased health risks because of their known toxic and allergenic effects on animals and human beings.

References

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Geodynamical transition in the mantle at the end of the Hadean

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The rock record begins around 3.9~Ga ago. Before, very little observations exist for what is called the Hadean eon. Our knowledge of mantle dynamics in the early Earth comes from small zircons found at Jack Hills (Australia) and Acasta (Canada) which can be as old as 4.2-4.4Ga, and from the composition of mantle derived rocks in isotopes coming from extinct radioactivities. It has been suggested, from geochemical studies on the Hadean zircons, that the Earth is already close to modern by 4.4Ga, having large continents Harrison *et al*., 2005), liquid oceans (Valley *et al*., 2002) and potentially plate tectonics (Harrison *et al*., 2005). The present work confronts this hypothesis to modeling of Xe isotopes produced by extinct radioactivites. We show that the transition from the Hadean to the Archean corresponds to a change in the thermal and mechanical regime of the Earth's mantle: the transition from magmatic to modern solid state mantle convection.