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Experiments on adsorption and desorption of Pt, Pd and Rh on different soil minerals

Y. Dikikh, **J.-D. Eckhardt**, Z. Berner, D. Stueben

Institute of Mineralogy and Geochemistry, University of Karlsruhe, Germany

detlef.eckhardt@img.uka.de

The environmental relevance of Platinum Group Elements (PGE) has strongly increased due to their emission from automobile-catalysts. A lot is known about the distribution of these elements roadside-soils, but the knowledge about adsorption, mobility and transformation is very little. The aim of this investigations was to study the adsorption of PGE by soil minerals and the potential remobilisation. Therefore different experiments with soluble PGE and typical soil minerals (kaolinite, quartz, calcite, feldspar, Mn-Fe-oxides) were carried out.

In batch experiments with both –individual and different combinations of minerals–, and column experiments the material was treated with low concentrated PGE solutions to constrain the different parameters which control the sorption behaviour of PGE and to find out the mutual influence of the different mineral phases. Subsequently, desorption experiments with natural waters on the loaded material were done to estimate the bonding strength of the individual PGE concerning the different soil minerals.

The results show evident differences in the adsorption behaviour of the three investigated PGE, caused by the species of the element in the solution. Each element builds other complexes –different in size, structure and loading–, due to its hydrolysis characteristics at a given pH value.

The investigated minerals have to be distinguished into two groups, quartz and feldspar having very low adsorption capacity and Mn-Fe-oxides, kaolinite and calcite with high adsorption capacity. Kaolinite and Mn-Fe-oxides are characterized by high specific surface and variable surface loading, whereas for calcite increasing pH, caused by buffer capacity of this mineral, might be responsible for precipitation of PGE-

hydroxides or -carbonates.

Sequential extractions of Mn-Fe-oxides loaded with PGE showed the significance of surface loading, as positive Pd-complexes were mainly adsorbed by Mn-oxides (having a negative surface loading), whereas Pt- and Rh-complexes were mainly adsorbed by Fe-oxides which have a positive surface loading.

The experiments demonstrated that the mineralogical and geochemical composition of the soil exerts a decisive influence on the fixation and mobilization of PGE. Clay-minerals, Mn-Fe-oxides and carbonates are components which in conjunction with high pH-values increase the bounding capacity of the soil for PGE.