Rare earth elements in soil profile and groundwater of a vehicle impound scrapyard

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The number of motor vehicles has increased drastically over the past decade in Brazil. As such, vehicle impound scrapyard (SIV) overcrowding has become a challenge in many Brazilian regions, and environmental problems associated with this activity are becoming more acute. Contamination by metals such as Pb, Fe, Cd and Ni under and in the vicinity of soils of discarded vehicle scrapyards have been reported in several studies,[1] but information about rare earth elements in this environment is scarce. Currently, one of the main end uses for rare earth elements (REEs) are for automobile catalysts and petroleum refining, as well as the use in fuel and oil additives, and more recently, also in electronic devices. The aim of this study was to evaluate the content of REEs in soil profiles and groundwater in the area of a SIV located in the city of Ribeirão Pires, a municipality in the metropolitan region of São Paulo state, Brazil. Three monitoring wells were installed, one upstream (PM1), without influence of the vehicles, and two downstream (PM2 and PM3). Sampling was performed with a mechanical probe and the wells were lined by a 2" diameter geomechanical PVC tube and filter. Nine samples were collected in plastic liners: four in PM1 (0-0.75 m; 0.75-1.30 m; 1.30-2.10 m; 2.10-2.70 m) three in PM2 (0-0.50 m; 0.50-0.85 m; 0.85-1.45 m) and two in PM3 (0-1.0 m; 1.0-1.75 m). Groundwater was sampled (one sample in PM1, two in PM2 and one in PM3) using a low flow peristaltic pump and pH, electrical conductivity, redox potential and temperature were measured with a a multiparameter probe. Water samples were filtered with using 60 mL plastic syringes coupled with 0.45 μm pore size PVDF filters. Soil samples were dried at 40 ºC and sieved (< 2 mm). Before and after sieving samples were disaggregated, homogenized, quartered. Samples were ground using agate jars and balls and a planetary mill. Neutron activation analysis was employed to determine REEs in soil samples, and ICP-MS was the analytical technique for groundwater analysis. The REEs mass fractions in the soil profiles varied between 0.083 and 137.9 μg/g in PM1, with significantly higher values in the first layer (0-0.75 m), between 0.52 and 99.1 μg/g in PM2 and between 0.33 and 121.9 μg/g in PM3. The groundwater showed the highest REEs concentrations in PM2 (0.02 to 3.29 ng/mL), followed by PM1 (0.005 to 0.33 ng/mL) and PM3 (0.002-0.14 ng/mL). Such values are in the range of expected REEs values in groundwater, considering physicochemical and sampling conditions. The chondrite normalized REEs patterns of the soil samples show enrichment of light REEs over heavy REEs, with a small positive anomaly of Ce in PM3. According to DERSA,[2] the main lithotypes of the area comprise granites and metamorphic rocks. Wedepohl[3] quotes average Ce values in granitic rocks as 104 μg/g, which is in accordance with the results of this study. Overall, the findings indicate that the values of REEs in the study area are, up to now, mostly geogenic.

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