

Cd and Ni are greatly accumulated in top soils. Correspondingly, from depth to top, Fe, Zn and Hg also accumulated, whereas Cu and As are depleted although Cu of HACM modes and As of SCM (simple continuous multifractal) in both deep and top soils. For other indices, including B, Cl, Br, C, F, Ga, I, K, La, Ca, Mg, Na, Nb, pH, Si, Sb, Rb, V, Y, and Zr, the behaviours of them in top soils are similar to those in deep ones. From the results above, it could be concluded that those elements accumulated gradually from deep to top soils are affected a lot by anthropogenic factors and those depleted much may be related more to the geological background of the areas. And especially the results got from the three kinds of spatial methods in environment assessment are in agreement with one another.

**Key words** fractal; multifractal; geostatistics; environmental assessment

## **Linking historical smelter emissions across Humberside (UK) to enhanced soil metal concentrations using geostatistics and preserved environmental samples**

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**Background:** Analysis of human malignancies on Humberside (UK) in 1984 showed an increased risk close to the site of the local smelter. Geochemical survey data for Pb and Sn in soil collected soon after the smelter closed showed elevated concentrations relative to local background levels, and a strong spatial trend related to the prevailing wind direction. No historical emission data existed and evidence associating the smelter with the putative soil contamination plume was considered equivocal. In this work we test the hypotheses that: a) historical data can be used to estimate the excess quantities of Pb and Sn in the soil; b) tree bark & attic dust can act as historical archives of particulate deposition; c) geochemical and mineralogical information assist in linking the source of the metal and the historical contamination plume. **Methodology:** Using the wider soil survey data, we subtracted soil median background concentrations for three parent material types outside the region of deposition from those samples within it. We then constructed a statistical model of metal deposition from these data. Excess metal concentrations were mapped by lognormal universal kriging with parameters for the trend and residuals modeled simultaneously using residual maximum likelihood. Tree bark and attic dust samples collected at increasing distance and in different directions from the smelter were then analyzed by SEM. This enabled the identification and characterization of heavy metal particulate populations in the tree bark and attic dust samples with respect to relative particle numbers, size, chemistry and shape. **Results:** Maps of excess heavy metals in soil suggest that they were deposited up to 24 km to the NE of the smelter by the prevailing wind. We estimated total excess metal in the soil to a 40 cm depth over the area of deposition to be 2500 t of Pb and 830 t of Sn. The dusts and tree bark samples contained particulates whose size, shape and composition were consistent with emissions from a Sn smelter. Bulk chemical analyses showed that Sn and associated elements declined with distance from the smelter stack in a manner analogous to the soil survey data. **Conclusions:** This study supports our hypotheses and provides evidence on the magnitude and distribution of historical metal contamination that could aid any subsequent epidemiological study.

**Key words** human health; soil; geostatistics; emission; heavy metal

## **Spatial and temporal distribution of polycyclic aromatic hydrocarbons in fine-grained sediments of the East China Sea**

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The nearshore mud area along the Changjiang (Yangtze River) estuary and the coast of Zhejiang and Fujian provinces, and the distal mud area to the southeast of Cheju Island, Korea are the modern accumulative centers, thus, being the "sinks" of pollutants such as Polycyclic Aromatic Hydrocarbons (PAHs) in the East China Sea (ECS). PAHs of surface sediment samples from the mud areas of

the ECS and a  $^{210}\text{Pb}$  dating sediment core collected using a gravity core from the coastal mud area in the ECS were quantified by GC/MSD with the internal standard materials. The  $\text{g}^{-1}$  (dry • concentrations of PAHs in the coastal mud area are 180.3 to 424.8 ng in weight), and the concentrations of PAHs in the distal mud area to the southwest  $\text{g}^{-1}$ . The distributional pattern of PAHs in the Cheju Island (117.1–211.7 ng) in the study area is controlled by the distance from their sources (e.g. the main land of China), grain-sizes and TOC of sediments which are closely related with the circulation system of the ECS. The PAHs in sediments are mainly pyrogenic. It is indicated that the pathway of PAHs in the distal mud area is mainly by atmospheric deposition and coastal mud area is mainly by river runoff. The high-resolution vertical variations of concentrations of 16 USEPA priority PAHs (TPAHs) have a close correspondence to the different phases of industry and agriculture development of China during 150 years. The two peaks of TPAHs concentrations in 1954 and 1998 are coincident with the severe flooding years in history of the Yangtze River. This work was supported by the National Natural Science Foundation of China (NSFC) (No. 40276016), Open Fund of State Key Laboratory of Organic Geochemistry, Guangzhou Institute of Geochemistry, and Ministry of Science and Technology of China (“973” Project No. 2005CB422304).

**Key words** PAHs; distribution; source; sedimentary record; the East China Sea

## Anthropogenic Pt and Pd concentrations in urban roadside soils from Xuzhou, China

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The increased use of platinum group elements (PGE) as automobile catalysts has led to concern over potential environmental and biological accumulation. These inputs are greatest in urban areas, with the major sinks being roadside soils. This investigation represents the first detailed study in China to characterize Pt and Pd concentrations and enrichment ratios in urban roadside soils. Roadside soil samples were analyzed by ICP-MS. Data from 21 roadside topsoil samples show the medians of Pt and Pd concentrations are 2.9 and 2.8  $\text{ng} \cdot \text{g}^{-1}$ , respectively. These values are higher than those of unpolluted soils in Xuzhou, which average 0.82 and 0.83  $\text{ng} \cdot \text{g}^{-1}$ , respectively. The relatively low Pt and Pd concentrations were expected due to recent introduction of catalysts to China (2000) compared to the prolonged use of catalysts in Europe and the USA. Hierarchical clustering analysis indicates that Pt and Pd in Xuzhou urban roadside soils are mainly from traffic emissions. Computation of enrichment ratios in unpolluted soils suggests that the Xuzhou roadside soils have enrichment medians of 3.53 for Pt (1.22-5.73) and of 3.37 for Pd (1.35-4.46). Lower Pt/Pd ratios (0.35-2.86) in relation to similar studies in other countries were observed due to different Pt/Pd ratios in China automobile catalytic converters. In general, fine fraction (<250  $\mu\text{m}$ ) contains higher Pt and Pd concentrations compared to the coarse fraction (250-500  $\mu\text{m}$ ).

**Key words** Pt, Pd; hierarchical cluster analysis; urban roadside soil; soil pollution; Xuzhou, China

## Groundwater arsenic pollution from Inner Mongolia and evidence of its occurrence

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In Inner Mongolia, the Hetao area (the Great Bend of the Yellow River) is a plain formed by the Yellow River and spreads along the river beyond its north bank. It is a rich agricultural region with a dense population, in which vast fertile land is irrigated with the water from the Yellow River in North China. The region has been a famous, rich and populous area since ancient times. In the Hetao area, alluvial Quaternary aquifers used for public water supply are contaminated with naturally occurring arsenic, which heavily affects the health of 180000 people there. Arsenic poisoning has emerged since the late 1980s among the inhabitants in the Hetao area. Arsenic content has reached 0.97  $\mu\text{g} \cdot \text{mL}^{-1}$  in well water (almost 20 times as high as the limit for drinking water) and 25  $\mu\text{g} \cdot \text{g}^{-1}$  in soil (5 times high as the world soil average content). About ten thousand square kilometers were affected by the pollution. Consumption of water and food supplies in this area has led to widespread death (around 71.1 % of the deceased was of relative arseniasis in 2894 investigated) and disease (44.6% suffering arseniasis in 857 investigated). In the area, some of the villages have been given up by the residents to avoid the poisoning. As an other case of arsenic pollution study and treatment in the world, researchers studied the arsenic pollution and poisoning in the Hetao area for years. Difference from the cognition has been accepted,