Geochemical mapping of soils for natural background and diffuse contamination patterns

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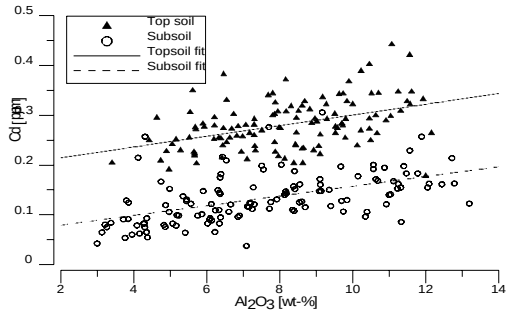
With the aim to define and distinguish natural and man-induced geochemical patterns (in both geographical and attribute space) in soils of the rural part of the province of Zeeland, the Netherlands, an extensive regional soil survey was carried out. At 235 locations in agriculturally used young Holocene marine clayey sediments, samples were collected at two depths (the plough zone at 5-30 cm and a C-horizon at about 40-80 cm), whereby the data from the deep samples were used to model the natural pattern. Focus was on the inorganic chemistry. Through XRF and ICP-MS a broad analytical spectrum was compiled, to gain insight into the factors and causes that determine the observed patterns.

Compared to the average composition of the continental crust, the Zeeland soils show for many elements, including Al_2O_3, a ratio of about 0.5. Elements that are enriched are the thalassofiles B and Li, the metalloids As and Se, and the elements Zr and Th (as measured by XRF) that are commonly found in heavy minerals. Cadmium, Pb, and Sb are relatively enriched in the shallow samples only. Other elements that show higher concentrations in the shallow samples are P_2O_5, S, Cu, Sn, Zn, and also As and Se.

An exploratory factor analysis revealed a clay factor, a carbonate factor, and an anthropogenic factor with high loadings of e.g. Cu and Pb, and fertilizer related elements P_2O_5 and Cd. Focussing on the anthropogenic elements, a differentiation in two or more influences can be made.

In view of the factor model, comparison between top and subsoil can best be made in relation to either Al_2O_3 as a proxy for clay content or CaO as a proxy for carbonate content (see figure below for Cd). At least in the young soils of the Zeeland region, the deeper soil appears to be a good proxy for "pristine", natural conditions.



Hydrogen Concentrations in Deeply Buried Marine Sediments: Determination of Concentrations and Utilization Rates

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During ODP Legs 190 and 201 we established and tested procedures for the measurement of hydrogen concentrations and utilization rates in deeply buried deep-sea sediments. During Leg 190, we analyzed samples collected from sites in the Nankai Trough accretionary prism with water depths ranging from 1,750 to 4,800 meters. These samples covered a sediment depth range of a few meters below the seafloor (mbsf) to 1,100 mbsf and spanned a temperatures of 3 to 100 ± 20 °C. During Leg 201 this work was furthered at sites that underlay low productivity regions in the Equatorial Pacific and high productivity regions on the Peru Margin. Temperatures ranged up to 25 °C and water depths from 150 m to 5,100 m. The rate measurements involved the development of a radio-tracer technique.

In shallowly buried coastal sediments, it has been demonstrated that hydrogen concentrations are controlled by the thermodynamics of microbially mediated hydrogen-consuming reactions. It has also been argued that the free energies of reaction for methanogenic hydrogen consumption approach an asymptotic limit (–11 kJ/mole methane) with depth.

In contrast, Leg 190 data, indicate that the free energy of reaction associated with hydrogen trophic methanogenesis fell within a narrow range, -27.5 ± 8.5 kcal/mole methane, between 3 and 20 °C and did not decrease with depth. The absolute value of the free energy is consistent with the energy required for ATP production.

Except for the site in the Peru Basin, hydrogen concentrations determined during Leg 201 were lower than those at Nankai by an order of magnitude on average. These new data will be used to further examine the controls on hydrogen and will be analyzed within the context of metabolic activities based on transport models of porewater concentration gradients of microbially controlled chemical species.