Understanding the fate of biogenic particles in carbon-limited, stratified lakes

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Abstract

There have been many observations of sub-surface turbidity maxima under stratified conditions in lakes, estuaries, coastal and the ocean. Particles produced via photosynthesis in the surface waters, or through re-suspension of bottom sediments, are temporarily halted by the sharp density interface found at the thermocline. Once trapped, if only for a relatively short period, at the thermocline these particles are subjected to the internal wave dynamics of the system. Over the past decade, we have increased our understanding of the effect of internal wave transport on particles that may be moved in and out of the photic zone, thus impacting on the particles’ photosynthetic capabilities. However, there has been almost no research on the fate of biogenic particles if the thermocline traps them below the photic zone. This ensures that the biogenic particles can only be subject to respiration, regardless of whether they are photosynthetically capable or not. We used field data, a three-dimensional hydrodynamic model and a one-dimensional advection-dispersion-reaction model to investigate the fate of biogenic particles once they escape, or are trapped, out of the photic zone. The field data and the three-dimensional numerical model were used to determine the sediment characteristics and also to establish where particles are transported by internal wave dynamics. The one-dimensional (in the vertical) advection-dispersion-reaction model, which assumed that the lake ecological processes were limited by labile carbon availability, was developed to investigate the dominant processes controlling the fate and vertical distribution of the suspended particles throughout the water column. Two non-dimensional numbers, the Peclet and Damköhler numbers, were used to determine the ratio of process timescales and therefore to generalize the results from our study site, to other stratified systems.
Peat – water interactions and resulting characteristics of coals

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Abstract

The characteristics of coals, such as their geometry, macroscopic appearance, organic and inorganic matter composition, and their quality, are to a high degree the result of initial interactions between peat, water and inorganic sediment within various peat-forming paleo-environments. In geological studies of coal facies, forest swamps, bush moors, herbaceous and moss plains are most often interpreted as the main types of peat-forming ecosystems having developed either within topogenous (eutrophic, groundwater fed) or raised (oligotrophic, rainfall fed) mires.

Topogenous mires, developed either within coastal paralic or intraland sedimentary basins, are characterized by saturation of the organic matter by the groundwater, considerable mineral matter influx, high amount of dissolved elements and nutrients, anaerob, alkalinity, and hence intensive microbial activity. The resulting humic coals are mostly ash-rich (up to 50 wt. %; db), sulphur-rich (1-5 %, extremely to 12 %; db), frequently characterized by organic fixation of Ca, and may contain increased contents of potentially toxic elements. Organo-petrographic composition depends on vegetation progenitors and early diagenetic biochemical processes. Xylike and charcoal rich coals originate from tree-and-bush dense flora having grown in areas of slightly elevated mire topography, where a slight oxidation could take place. Fine detrital coals, by contrast, derive from herbaceous, moss and water plants vegetation having flourished in topographically lower terrains. Due to water chemistry and bioactivity, topogenous coals are gelified (homogenized) to a higher degree than coals originating from the raised mires. The most open-water conditions are expressed by liptinitic components and finally by formation of sapropelic coals.

The characteristics of the raised mire coals are opposite to those of the topogenous coals. In concavely shaped raised mires, mineral matter influx from the hinterland is prevented. Water saturation is fed by rainfall, which must be constant and considerable. If not, accumulated biomass is reworked (oxidised) and the residual sediment transforms to the mineral-rich one. Most clean coals of the world originate from the (unreworked) raised mires.

Slovenian coals, both paralic and intramountain, are interpreted as prevailing topogenous. This is one of the key answers to the questions about their petrology and quality.
Distribution of total copper and organic matter in the sediments of two Mediterranean basins subjected to different levels of pollution

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Abstract

The study areas, two shallow semicircular basins, are subjected to different pollution levels from various land-based sources. The distribution of total copper and organic matter in the sediments was investigated in Abu-Kir Bay along Tabia Sector (TS), representing major industrial outfalls and Madia Sector (MS), representing typical estuarine system, as well as in the Eastern Harbor (EH). The distribution of sediments was a function of bottom configuration and current regimes. The sediment types, organic carbon and copper content varied regionally according to contamination sources. Although EH acts as an accumulating area for organic matter from untreated sewage discharges, the organic content in its sediments was not so high, due to its short flushing rate (6 months) and/or its slower sedimentation rate from active stirring up by wind action. Dumping of antifouling paints from shipyard in EH participated in metal sediment pollution, especially copper, as confirmed from its high average concentration compared with those at TS and MS. The seaward decrease in copper was observed at MS, reflecting possible source from algaecide copper sulfate discharged from Lake Edku. The relation between copper and organic matter at MS confirms their tendency to form organometallic complex. The higher copper concentrations at TS coincided with major industrial discharges. The positive correlation between organic matter and clay fraction at TS indicates their common sources from industrial outfalls. The comparison with earlier data illustrates ten times increase in copper concentrations during recent years in study areas, following progressive increase in population and consequently in amounts of discharged wastes.
Relationship between the sediment geochemistry and internal phosphorus loadings in a Great Lakes coastal marsh, Cootes Paradise

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Abstract

Cootes Paradise is a coastal wetland, adjacent to Hamilton Harbour at the western tip of Lake Ontario. The marsh has been considerably degraded due to the excessive sediment and nutrient input from sewage treatment plants (STPs), marsh tributaries and Combined Sewer Overflows (CSOs). Various strategies were initiated to improve the water quality in the marsh. Although there has been reduction in nutrient loadings from external sources, high nutrient levels, and a prolific algal growth remain major stresses, affecting the water quality in Cootes Paradise. To assess the importance of external versus internal nutrient loadings to the marsh, nutrient fluxes from sediments were estimated using porewater profiles at three locations in 2001 and five additional sites in 2002. The fluxes varied between 0.27 and 5.25 mg P m⁻² d⁻¹, with sites receiving outfalls of STP and CSO having highest fluxes (~5mg P m⁻² d⁻¹). Mean phosphorus release rate of 2.02 mg P m⁻² d⁻¹ was calculated from the spatial distribution of the non-apatite inorganic phosphorus (NAI-P) in sediments, employing a relationship between the NAI-P and P fluxes. The results confirm that sediment P geochemistry is important in regulating the P concentrations in porewater which, consequently, govern the P fluxes from sediments. The sediments also provide historical record of nutrient contamination, resulting from large volume of runoff bypassing the STP and entering the marsh via a small creek directly during Hurricane Hazel, which struck Southern Ontario in 1954.
Effect of wetting and drying on phosphorus forms in upland stream sediments

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Abstract

Long periods of desiccation and saturation are central to P transformations in upland sediments. We used ³¹P nuclear magnetic resonance (NMR) spectroscopy and the EDTA-fractionation scheme to determine P forms in both wet and dry stream sediments. Samples were obtained from 0-20 (root mat), 20-40 and 40-60 cm depth of sediment from an upland stream that flows in winter but not in summer when sediments desiccate to about 30 cm. Total P, C and N in the sediment decreased with depth and was significantly less in desiccated sediment to 40 cm depth. Chemical fractionation of P forms indicated that the majority of P was extractable by NaOH, with total organic P increasing from about 40 % in the 0-20 cm depth to 60 % at 40-60 cm depth. With desiccation, the greatest increase was in Ca associated P, followed by P extractable by NaOH and Fe-P. Dramatic changes in organic P with depth were investigated by NaOH-EDTA extracts of sediments, which extracted from 75-95 % of total P. The major form of organic P detected was orthophosphate monoesters followed by orthophosphate diesters. More phosphonates were detected in the 20-40 and 40-60 cm depth of wet, winter than desiccated, summer sediment, whereas pyrophosphates were detected in all but the deepest desiccated sediment. Orthophosphate diesters present in the deepest wet sediment were absent from the dry summer sediment at the same depth. These results emphasize the lability of orthophosphate diesters, the protection and storage of organic P largely as recalcitrant orthophosphate monoesters with depth, and the dynamics of phosphonates and pyrophosphates in wetted and desiccated sediments.
Mobility of metals in lake sediments exposed to experimental and natural redox changes

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Abstract

The role of sediments in the cycling of 16 metals and other elements was studied in a eutrophic dimictic lake (Turingen, Sweden) by frequent in-situ monitoring and experimental manipulations. Parameters included concentrations of major elements (Al, Fe, Mn, inorganic and organic C, S, Cl), major trace elements (Cr, Co, Ni, Cu, Zn, Pb), minor trace elements (V, As, Mo, Ag, Cd, Tl, Hg), and environmental conditions (temperature, O₂, Eh, pH, conductivity, absorbance, turbidity). The environmental control of element fluxes across the sediment-water interface was assessed by comparing multivariate time series in sediment traps and in the deep water of the lake with those above intact sediment cores that were incubated over 10 months. Incubation regimes included aerobic/anaerobic conditions as well as redox changes induced by stepwise stimulation of microbial activity to mimic the seasonal cycles in the lake.

Combined results suggest that the links between sediment and overlying water are often weak or indirect. For example, concentrations of Hg above isolated sediments remained fourfold lower than in the deep water of the lake at corresponding conditions, even after several months of anoxia, and returned to baseline levels within days to weeks after addition of Hg-contaminated water. At highly reducing conditions, however, concentrations of several elements rapidly increased severalfold, but remained again manyfold lower above isolated sediments than in the deep water of the lake.

Based on the changes of concentrations and concentration ratios, the cycling of some metals but not others was closely coupled to the redox-sensitive cycling of Fe. Further, comparison of natural and experimental changes suggests that the influence of redox changes on the remobilization of a given element can be substantial or negligible depending on conditions, and that experimental assessments of mobilization from anoxic sediments may be misleading if incubation is conducted in a closed system isolated from biological processes in the water column.
Study of Categorizing Input Data Effects on Sediment Estimation Using Neural Network

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Abstract

Knowing the fact that sediment transport phenomena produce many problems in water resources' systems, estimation of sediment discharge becomes very important. Furthermore, sediment transport has a complicated behavior in natural and artificial streams. In fact, many parameters have a key role in production and movement of sediment in the streams. Consequently, estimating sediment discharge requires more elaborations.

Nowadays Neural Networks (NNs) simply solve many real-life complicated problems. In this research ANN is used to estimate sediment discharge. The learning algorithm is used to tune the parameters of the multi-layer feed forward network is the Marquardt-Levenberg. Two different designs based on the kind of inputs imposed to the network are made. For the first designed network, inputs are: Discharge, width, depth and slope of the flow, also sediment’s median size, with the output of sediment discharge. Inputs of the second designed network include: depth, velocity, hydraulic radius and slope of the flow and sediment’s median size with the same output. Although, the performance of the networks for normalized inputs is very promising, we will face small errors for many cases and some relative large errors in a few cases. The large errors lead us to the existence of non-homogeneous data. To remedy this problem, the first set of data is separated into two major groups, group one contains data with flow discharge more than one cf (cubic feet per second) and group two has the data with flow discharge less than one cf. In order to have more homogeneous data, we categorized the input data into two clusters according to the type of flow; like sub critical or super critical flow. Consequently this results in fewer errors.
Paleolimnological reconstructions from isotopic compositions of lake sediment organic matter

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Abstract

The stable isotopic compositions of carbon, nitrogen, and hydrogen in lake sediment organic matter are valuable in reconstructing the paleoenvironmental history of a lake and its surroundings. Sedimentary organic matter comprises the residues of the various aquatic and land plants that formerly lived in and around the lake. Organic geochemical parameters consequently reflect the environmental conditions that controlled the amounts and kinds of plants that lived at different times in the past. Algal sources of the organic matter can be inferred from low C/N ratios, whereas high C/N ratios indicate land-plant organic matter. Details of organic matter origins and alterations are provided by biomarker molecular compositions. Changes in aquatic paleoproductivity rates are indicated by variations in organic carbon mass accumulation rates and in Suess-effect-adjusted carbon stable isotopic compositions. Nitrogen isotopic compositions can record changes in paleoproductivity but are also sensitive to changes in lake stratification. These parameters are consequently proxies for rates of delivery of soil-derived nutrients to lakes and of in-lake nutrient recycling. Changes in the proportions of C3 and C4 land-plants in semi-arid regions can also be inferred from carbon isotope compositions of lake sediment organic matter. Hydrogen isotope compositions of biomarker compounds record the paleohydrologic balances of lake systems. Applications of organic geochemical proxies to latest-Pleistocene to modern paleoclimatic and paleoenvironmental reconstructions will be illustrated with lake sediment records from Brazil, North America, Europe, Africa, Siberia, and Japan.
Determination of trace metals in porewater from the Adriatic Sea coastal sediments by HR ICPMS

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Abstract

Knowledge of the distribution of trace metals in porewaters is needed in order to understand the biogeochemical behaviour of trace metals in aquatic sediments as well as various processes which are taking place both in sediment and at the sediment/water interface. However, measuring trace metals concentration in porewater is not an easy task, especially in the marine environment, since concentrations of most metals are very low and the chemical composition of porewater creates a complex matrix which can interfere with metals determination. In addition, small sample volume usually prevents improving of the detection limits of the used analytical method by preconcentration so that direct determination of metals in the original sample is required. The method of choice for metals determination in porewater is than ICPMS (inductively coupled plasma mass spectrometry) which offers very low detection limits in combination with multielemental approach.

In this work application of high resolution (sector field) ICPMS for determination of various metals in porewaters from coastal sediments is described. Several sediment cores from the Kastela Bay and the saline Rogoznica Lake (central part of the eastern Adriatic Coast) were sampled by scuba diving. Cores were cut under inert atmosphere and porewater was isolated by centrifugation and filtered. Twenty metals (Al, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Li, Mn, Mo, Ni, Pb, Sn, Ti, U, V, Zn) were determined in these porewater samples by HR ICPMS. For comparison, some analyses were also made by ICPAES (inductively coupled plasma atomic emission spectroscopy) and by quadrupole ICPMS. Optimum analytical conditions for determination of particular metals and obtained detection limits will be discussed. The behavior of analyzed metals in porewaters from different sediment environments, characterized with different degree of anoxia, will be also discussed.
$^{210}$Pb transport by sinking particles at two selected sites of the Southern Adriatic and Ionian seas

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Abstract

Two moorings were deployed in the southern Adriatic basin (1200 m depth) and in the Ionian Sea (2400 m depth) for a two-year sampling (March 1997-March 1999). Each mooring was equipped with 2 sediment traps, 150 m below the surface and 150 m above the bottom. To assess particle fluxes and their control mechanisms, biogenic and lithogenic constituents were analyzed. $^{210}$Pb activities, fluxes and inventories in sediments were used to obtain independent information. Mass fluxes presented a temporal variability that appears to be related to the seasonal biological production, especially at the Ionian station. A coupling between fluxes measured by surface and bottom traps is evident, even if a contribution by lateral advection occurs at both stations. In the Adriatic, measured fluxes varied from 0.5 to 507 mg m$^{-2}$ d$^{-1}$ and from 0.3 to 833 mg m$^{-2}$ d$^{-1}$ at the upper and lower trap, respectively. At the Ionian station, mass fluxes ranged from 2.6 to 231 mg m$^{-2}$ d$^{-1}$ at the 150 m depth trap and from 0.3 to 249 mg m$^{-2}$ d$^{-1}$ at the 2250 m depth trap. The strong correlation between $^{210}$Pb and mass fluxes at both stations suggests that the driving mechanism for the downward transport of the radiotracer is the variability of the amount of sinking particles. Measured fluxes are discussed with respect to mass accumulation rates (from $^{14}$C dates) and $^{210}$Pb inventories in sediments.
Source and distribution of organic matter on the western Adriatic continental shelf

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Abstract

Continental shelves play an important role in the global carbon cycle because they represent the largest modern repository of particulate organic carbon. The distribution of terrestrial organic matter is tightly linked to the dispersal of riverine sediment and its deposition occurs together with marine organic material, mostly originated from planktonic production. A fundamental need is to assess the nature and fraction of the terrestrial organic carbon preserved in marine sediment. The isotopic composition of organic matter in marine sediments is used to identify its source and transport pathways. The Adriatic basin is a narrow, low-gradient, epicontinental shelf. The primary fluvial input entering the Adriatic Sea is the Po River. The Adriatic dispersal system extends SE from the Po for ca. 700 km, with additional contributions from many smaller Apennine Rivers. Fluvial sediment is initially deposited on the prodeltas with an efficient transport along the shelf following the general current circulation.

The highest organic C contents (up to 2.2 %) were measured in the Po prodelta with no clear seasonal variability. In the central Adriatic the contents range from 0.1 to 1.2 %, with slightly higher values toward the bottomset region and negligible along-shelf variability. Within the Apennine rivers, we did not find clear evidences of localized organic C input.

The values of $\delta^{13}C_{org}$ become less negative from the Po river mouth along the sediment dispersal system, which implies the decrease in the contribution of terrestrial organic carbon and the increase of marine carbon. The signature of terrestrial $C_{org}$ is almost lost at about 9 km offshore the Po river’s mouths. Nevertheless, the proportion of terrestrial organic matter prevails in sediment accumulating north of the Pescara river.
Metal contamination in suspended matter and sediments: the junction of Fensch and Moselle rivers, France

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Abstract

The Moselle river flows in the north-east of France, from Vosges Mountains to neighboring countries Luxembourg and Germany. One of its affluents, the Fensch River, drains a highly industrialized valley, strongly affected by mining and smelting activities of iron and coal. The objective of this work, taking part of a general research program on Moselle Watershed (Zone Atelier Moselle) was to assess the impact of the polluted Fensch river on the global quality of the Moselle river. For that purpose, mineralogical analyses (XRD and FTIR), chemical analyses (ICP-MS) and microanalyses (SEM and TEM) were performed on sediments, suspended particulate matters collected in the Fensch river, and in the Moselle river upstream and downstream the junction. From a mineralogical point of view, a logical link could be drawn between suspended matter and sediments from a same sampling location. Iron-rich minerals were observed for every material from Fensch river and this mineralogical fingerprint could be detected as well on solids collected in the Moselle river downstream the junction.

Major and trace elements concentrations were obtained on two different granulometric fraction (0-2mm and 0-50 mm) revealing the enrichment in heavy metals of the fine particles. Metal speciation was evidenced through chemical extractions, and electronic microscopies. As, Cr, Pb, Zn and Sn were omnipresent in sediments and suspended matter. Their respective concentrations were always higher for Fensch river samples, and intermediate for solids collected downstream the junction. Chemical speciation varies from Fensch river to Moselle river samples, revealing the high anoxic character and high content in organic matter of the polluted river.
Effects of different land use on hyporheic communities of four river systems from central Slovenia

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Abstract

The hyporheic zone is saturated interstitial areas beneath the stream bed and into the stream banks where surface water mixes with ground water. The zone is a site of high biological activity where remineralization of organic matter from surface waters takes place. Physical and chemical conditions and hyporheic invertebrate communities of four rivers from central Slovenia, differing in intensity of land use activities such as canalization, pollution and eutrophication, were compared. The Podlipščica valley is the most affected due to intensive agriculture and canalization. The downstream of the Iška River is exposed to continuous exploitation of bed sediments and intensive water extraction. The Borovniščica is also regulated and influenced by farming, but not as intensively as Podlipščica. The least affected by human activities is the Želimeljščica River. Twelve sampling sites were selected along each river channel and sampled in summer 2002. At each sampling site, 3 times 10 litres of interstitial water were extracted from depth between 30 and 60 cm using the Bou-Rouch technique. The water chemistry of four rivers did not varied significantly. The mean concentrations of nitrates in the interstitial water were between 3 and 4.3 mg l⁻¹. The Iška and Borovniščica sediments showed higher permeability and lower amount of organic matter than sediments of Želimeljščica and Podlipščica. Taxonomic richness, diversity and evenness indexes were the lowest in the hyporheic zone of the Podlipščica River, which is the most intensively modified by human activities. Stygobionts (groundwater dwelling organisms) were rare in the sediments of that river.
Use of various matrix modifiers for the determination of Cd and Pb by ETAAS in sediments after close vessel microwave assisted digestion

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Abstract

Palladium nitrate is frequently used as a matrix modifier that appreciably reduces matrix effects in determination of Cd and Pb by ETAAS. It enables rising ashing temperature up to 750 and 800 °C without losses of Cd and Pb atoms, respectively. In sediment analysis various digestion procedures are applied for decomposition of samples. Digestion of samples in open platinum beakers is reagent and time consuming, including evaporation of a mixture of nitric, hydrochloric and perchloric acids and decomposition of silicates by repetitive addition and evaporation of 30 cm³ of hydrofluoric acid, followed by dissolution of the residue in diluted nitric acid. However, in decomposed sediment samples Cd and Pb are accurately and reliably determined by ETAAS, using palladium nitrate as a matrix modifier at elevated ashing temperatures.

Close vessel microwave assisted digestion procedure is more rapid using a mixture of nitric, hydrochloric and hydrofluoric acids. It is also more economic and environmentally acceptable since only 2 cm³ of hydrofluoric acid is necessary for quantitative decomposition of silicates. The vessels are then opened and boric acid is added to dissolve fluorides. In the final solution of decomposed sediment samples Cd and Pb are determined by ETAAS. By the analysis of standard reference materials of sediments it was experimentally proven that palladium nitrate used as a matrix modifier for rising ashing temperature, leads to substantial losses of Cd and Pb atoms that result in 20 to 50 % lower analytical results. Boric acid used in sample decomposition presumably releases Cd and Pb atoms occluded by palladium, causing their losses at elevated ashing temperatures. Therefore, the aim of our work was to optimize the measurement parameters for the reliable determination of Cd and Pb in sediments by ETAAS after close vessel microwave assisted digestion procedure. For this purpose 5 ml of 21 % v/v nitric acid was added to the graphite tube before ETAAS determination with Zeeman background correction. Careful drying of the sample was applied with a slow temperature ramp to 150 °C and ashing temperatures 350 °C for Cd and 400 °C for Pb. It was demonstrated that addition of nitric acid provided for even drying within the graphite tube and also considerably reduced non-specific absorption in Cd and Pb determinations by ETAAS due to chemical modification of matrix constituents to nitrates. Elevated ashing temperatures are therefore not required. Good agreement between certified and determined values of sediment standard reference materials were obtained, with the repeatability of measurements for Cd and Pb better than ± 5 %. The optimised analytical procedure was successfully applied in the determination of Cd and Pb in the river sediments by ETAAS after closed vessel microwave assisted digestion.
Evaluation of mineralogy and water-rock interaction in a brackish lake: Lake Acigol in Western Turkey

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Abstract

Lake Acigol in western Turkey is a perennial lake with a brine composition of Na-CI-SO₄. The lake is fed mainly by two distinct water sources. The first is groundwater of Mg-HCO₃ type, the second, springs of the Na-SO₄ type issuing in the southeastern part of the lake. The difference in composition of inflow waters is attributed to different ways of cycling waters. The mineralogy of the Lake Acigol was studied by means of 72 sediment samples collected along two lines (E-W and NW-SE) in the basin and 12 water samples collected from the lake and several springs. The ephemeral mudflat around Lake Acigol is composed of gypsum, calcite, dolomite and huntite, together with small amounts of clastic minerals (e.g. quartz, feldspar, clay). A brine-soaked mudflat contains efflorescence of halite, bloedite, thenardite and/or mirabilite precipitating from the artesian groundwater. Some of the calcite is no doubt transported from surrounding formations while some is formed from the diagenesis of gypsum which is the dominant mineral component of the basin. The transition from aragonite deposition in the lake and huntite formation in the dry mudflat indicates that these minerals are formed by alteration under a progressive evaporation. The dominance of aragonite and high total organic carbon (TOC) values recorded in the gel-like lake sediments are indicators of bacterial activity in the lake. Fluid-mineral equilibria calculations performed on the waters of the Lake Acigol basin successfully predicted the precipitation of minerals detected in the recent sediments.
Distribution of Heavy Metals under Conditions of an Urban Small Stream

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Abstract

Heavy metals belong to the most dangerous contaminants entering urban watercourses. Their toxic impact depends on the form of incidence; they are toxic mainly as dissolved ions. Although heavy metals tend to bind into a solid phase (sediment), where they are relatively unavailable for organisms, their behaviour and possibility of releasing to the water phase under changing conditions (pH, hardness, coincidence of other ions...) of urban small streams has not been quite clarified till this time.

A set of laboratory experiments under various conditions of water environment has been carried out to identify equilibrium time of chosen metals distribution (Cu, Zn and Pb) between the solid phase and water solution and to observe the metals behaviour during experiment. During experimentation samples of deionized water as well as water from an urban small stream and standard as well as real sediment material have been used in batch adsorption tests based on EPA methodology.

During long-term field monitoring of a small urban stream impacted by urban drainage results of laboratory experiments are verified and risk of heavy metals is assessed.

High differences among observed metals behaviour were identified: Equilibrium time differs among these metals and remobilization behaviour during experiment also varies. Each of the metals prefers different geochemical fraction in sediment: Pb residual fraction, Cu organic matter and Zn carbonates, it means different availability of the metals for aquatic organisms and diverse level of hazardousness for the aquatic ecosystem; Zn shows the highest tendency to release from solid phase into water and also its concentration in body tissue of benthic organisms reach high values.
Development of phanerogames in the northern Adriatic Sea

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Abstract

Marine phanerogames, considered the climax community of the Mediterranean infralitoral, are an extremely complex and structured community sensitive to environmental stresses. The ecological role of phanerogames is to stabilize the sea bottom through development of roots and lowering wave intensity, and consequently stabilizing the coasts. The development of high oxygen level and organic matter production is due to intense photosynthesis. The organic matter produced is food for various species of fishes, cephalopods and crustaceans linked into various complex food webs.

We studied the phanerogames *Zostera marina, Nanozostera noltii, Cymodocea nodosa* in the area of Gabicce Mare in the northern Adriatic off Marche (Italy). This is one of the rare examples of phanerogame seameadow on the Italian Adriatic coast. The development of these communities depends on the physical (salinity, radiation, turbidity), chemical (nutrients) and biological characteristics of waters as well as on sedimentological (especially grain size) properties. The scope of this study was to decode the differences between locations situated within the seameadow and outside.
Modification of COD in hyper-concentrated sediment-water system

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Abstract

Chemical Oxygen Demand (COD) has been one of the major indicators widely used for assessing organic pollutions in Chinese rivers. However, misunderstandings often occur for some rivers with hyper-concentrated sediment-laden flows due to the distorted COD. Moreover, accurate measurement of COD in such cases would be very difficult. Therefore, it is necessary to find alternatives that could well reflect organic pollutions in hyper-concentrated sediment-water system. In this paper, the change of Sediment Oxygen Demand (SOD) and COD in the water were investigated using batch experiments with given sediment concentrations ranging from 20-500kg/m$^3$, whilst experiments were also made on the dissolution properties and partition behaviors of the Sediment Organic Matter (SOM) in the hyper-concentrated sediment-water system. Sediment samples were taken from two monitoring stations, TongGuan (TG) and SanMenXia (SMX), located at the middle reach of the Yellow River. The results showed that the SOM is closely related to SOD, while the DOM (Dissolved Organic Matter) is well correlated to the COD. It was found that relationship either between SOM and SOD or between DOM and COD will be altered essentially upon sediment concentration exceeding the threshold about 100kg/m$^3$. The relationships and mechanisms were fully discussed for sediment concentration greater than 100kg/m$^3$, and an alternative to assess organic pollutions was proposed with consideration of the major factors (such as electricity strength and pH) which may influence DOM and its chemical components.
Estimating paleo-flows in lowland meandering streams on example of the River Spree, Germany

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Abstract

Environmental engineers, practitioners and ecologists are often trying to compare objectively the contemporary human-impacted environmental conditions with some reference states usually addressed to the pre-industrial periods. Methods of pale-limnology based on the analysis of algae fossils in sedimentary deposits provide the modern tool allowing for determination of most important substances and their concentrations in paleo-flows. However for estimates of balance terms one needs to supplement the pale-limnology methods with the information on paleo-flow discharges and this is a task of pale-hydrology and the goal of this study.

This paper presents the results of a multidisciplinary research designed to reconstruct environmental conditions of the paleo-flow of the Spree River in Germany. The study comprises of field investigations of channel geometry with the methods of paleo-limnology and numerical computations of mean annual and maximal channel discharges in the reconstructed oxbow lakes. Paleo oxbow lakes outlined on the infrared aerial photographs were selected as the objects of the study. To reconstruct planar geometry of paleo-stream meanders we applied the theory of sinus-generated patterns. Flow velocities were computed with the three-dimensional analytical model based on Rozowski approach for secondary helical currents. Parameterization of the model was performed on the data of detailed field investigations carried out on a meandering river reach of the contemporary Spree River near the village of Neübrück. Computations were compared with an alternative analytical approach developed by Grishanin and based on the principle of self-regulation of the alluvial channels. Although the results of computations have indicated close agreement between two methods applied to paleo-channels, for the contemporary channels they were markedly different on the account of anthropogenic factors.
Factors controlling retention of non-polar organic contaminants in Baltic Sea sediments

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Abstract

In sediment studies, concentrations of non-polar contaminants are often normalized to dry weight. In the aquatic environment, these contaminants, by origin, are to a large extent retained in various organic matrices that sooner or later are deposited in the sediment. Thus, concentrations of these compounds are also often normalized to organic content and sometimes to lipid content. Due to the adsorptive capacity of soot particles and inorganic carbon these compartment in sediments has also been discussed as important matrices for retention of non-polar compounds in sediment. However, in Baltic Sea sediments, none of these parameters alone can be used to normalise concentrations in a way that describes the variations of, e.g., PCB and DDT congeners. Thus we lack a useful basis for normalisation of data for non-polar contaminants in sediment and we also lack satisfactory information on which sub-fractions that actually retains non-polar contaminants in sediments. Since long it is known that sulphur acts as a lipophilic compound when sediment samples are extracted for analysis of contaminants such as, e.g., PCBs and DDTs. Sulphur co-elutes with hexane during the extraction of lipophilic compounds and interferes with the contaminant peaks in the chromatograms, thus hampering the determination of contaminants. In the deeper water layers of the Baltic, hypoxic/anoxic conditions often prevails, subsequently leading to more or less dense mats of the sulphur fixation bacteria Beggiatoa \textit{sp}. Depending on the redox conditions more or less elementary sulphur will be produced. In this study, we check to what extent elementary sulphur act as a retention force in sediment for non-polar components. As a model substance for non-polar components we use PCB.
Assessment of $^{129}$I in marine sediments from the Adriatic Sea

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Abstract

$^{129}$I is a long-lived ($t_1 = 15.7$ Myr) naturally occurring radioisotope. In the environment, $^{129}$I is formed by natural processes, such as spontaneous fission of uranium and interactions of cosmic ray particles with xenon.

The only stable iodine isotope is $^{127}$I and the natural $^{129}$I / $^{127}$I ratios are significantly influenced by releases of anthropogenic $^{129}$I to the environment. The main sources of anthropogenic $^{129}$I are nuclear fuel reprocessing plants. In Europe they are located at La Hague, France and Sellafield, Great Britain from which the estimated input of $^{129}$I to the Northeast Atlantic, Nordic Sea and Arctic by the year 2000 was 2978 kg. Because of its long half-life $^{129}$I has great potential as a specific oceanographic tracer for the study of the movement of water masses, transfer of radionuclides and marine cycles of stable elements such as iodine and carbon.

In our work we investigated the content of $^{129}$I in sediments collected from the Adriatic Sea. Radiochemical neutron activation analysis was used for the determination of $^{129}$I and $^{127}$I. For $^{129}$I determination the main issue is the pre-concentration of $^{129}$I from the samples. We optimised the disintegration of the samples by alkaline fusion (KOH), the conditions needed to trap iodine on charcoal after its oxidation and improved the purity of the charcoal. The method was developed, optimised and validated using the reference material Radionuclides and trace elements in soil, IAEA-375. The results found for the marine sediments investigated in this work will be discussed.

Determination of traces metal in the Seine estuary porewaters by the DGT technique

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Abstract

Porewater metals profiles are important for identifying redox horizons and understanding sediment geochemistry. The studies undertaken at the millimeter scale in sediment increase our knowledge in trace metal uptake and release processes.

Diffusive Gradient in Thin films (DGT) technique allows the realization of high resolution profiles in sediment. However, the presence of DGT device in sediment induces depletion in porewater metal concentration, which could be counteracted by resupply from solid phase.

In a similar way to the dialysers, the principle of the DGT is based on the diffusion of molecular species through a gel and with their accumulations on an exchange resin. The presence of this resin induces a gradient of concentration with the natural environment, which depends on the Fick’s first law of diffusion. The preconcentration is controlled by the time, the surface and the thickness of diffusion gel and finally by the diffusion coefficient, which is specific for each species. However, the deployment of the DGT in the sedimentary medium displays also some drawbacks; for instance, the preconcentration rate is not constant during the deployment time of trace metals and is accompanied by a possible depletion of the species in porewater. The information acquired by the DGT is then not easily interpretable in terms of concentration.

This work is focused on this last aspect. For this purpose, four DGT probes were deployed for 2 periods (38 and 960 hours) in the Northern Mudflat of the Seine estuary. Fe, Mn, Cr, Cu, Cd and Pb were preconcentrated on the chelex 100 and the resins were analyzed by ICP-AES or ICP-MS. The results were interpreted in comparison with the diageneric mechanisms corresponding to the mineralization of organic matter and following the topometric evolution of the mudflat during the exposure of the gel using an Altus apparatus.
Changes in sediment sources following wildfire in mountainous terrain: a paired-catchment approach, British Columbia, Canada

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Abstract

Wildfire events are often expected to result in increased rates of soil erosion and sediment redistribution within river basins. In addition, the removal of the vegetation cover and changes in soil properties often result in an increase in mass movement events and bank erosion. However, few studies have been able to quantify the changes in sediment sources as a result of wildfires. Such information is essential for effective resource management and for mitigating the effects of wildfires, especially given the concerns that increased sediment supply to rivers may be detrimental to aquatic ecosystems. This paper describes a field investigation into the effects of a wildfire event on sediment sources in catchments in the interior of British Columbia, Canada. Samples of source materials and actively transported sediment in rivers were collected from two catchments: one that had been severely burnt and a nearby unburnt (reference) catchment with similar characteristics. Source material and mobilised sediment samples were analysed for a range of properties (including mineral magnetic, geochemical and organic properties) in order to explore the main sediment sources in the unburnt and burnt catchments. Preliminary results are discussed in the context of fire-induced changes in the dominant sources of sediment reaching the river network in this mountainous area of British Columbia. The relative value of the different tracer properties is assessed.
Effect of Sediment Structure on Hyporheic Exchange and Pore Water Transport

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Abstract

Hyporheic exchange is known to provide an important control on nutrient and contaminant fluxes across the stream-subsurface interface. Similar processes also mediate interfacial transport in other permeable sediments. Recent research has focused on understanding the mechanics of these exchange processes and improving estimation of exchange rates in natural systems. While the structure of sediment beds obviously influences pore water flow rates and patterns, little is known about the effects of typical sedimentary structures on hyporheic exchange and other transport processes in permeable sediments. We have conducted a variety of experiments to observe the interaction of overlying flow conditions, the development of sediment structure, pore water transport, and net stream-subsurface exchange. Differential transport of mixed-size sediments causes the development of a coarser armor layer that facilitates enhanced pore water transport near the surface of the sediment bed. Complex heterogeneous sediment structures can form throughout the bed as sediments are mobilized, transported, sorted, and deposited. This complexity in the sediment structure produces equivalent complexity in pore water flow patterns. Solute and colloid transport preferentially occurs through high-permeability regions of the sediment bed, so that the rate of interfacial exchange increases with increasing sedimentary heterogeneity. Heterogeneity can also produce an effective anisotropy in the bed that favors horizontal transport while limiting vertical penetration. The overall implications of these processes for solute and particle transport in permeable sediments will be discussed.
Fluxes of Iron and Manganese across the Bottom Water-Sediment Interface under Various Redox Conditions

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Abstract

Studies of fluxes of dissolved forms of iron and manganese across the water-sediment interface were carried out in the Gulf of Finland and Vistula Lagoon (Baltic Sea), and Golubaya (Rybatskaya) Bight (Black Sea) from 2001 till 2004. Fluxes of metals were measured in situ using an autonomous benthic lander in the Gulf of Finland. In all other cases landers were set up and operated by divers. Distribution of these metals in porewater and in sediment was also investigated. The aim of this work was to study the influence of redox conditions on the fluxes of dissolved iron and manganese.

It was found that flux of iron depends on redox conditions in bottom seawater. When concentration of oxygen is higher than 100 mM, the flux of iron is absent. Under lower concentration of oxygen and absence of hydrogen sulfide an active release of iron from sediment occurs. Under anoxic conditions the flux of iron decreases. This behavior of iron was observed both in case of stations with originally different redox conditions and in long chamber experiments when redox conditions inside the chamber change from oxic to suboxic and anoxic.

In general, the flux of total dissolved iron is mainly defined by the flux of iron(II). The contribution of iron(III) to the flux of total iron is small compared to iron(II). Organic iron is present in large amount, but does not contribute to the exchange of iron, and its flux is usually absent. In the case of manganese the direct relation between flux of manganese and its concentration in porewater and solid phase of upper sediment layer was observed. However, redox conditions do not affect the value of the flux.

Besides, the importance of the anthropogenic influence for the fluxes of dissolved forms of iron and manganese was indicated.
Stability of in-stream habitats in small lowland streams – interactions between sediment, flow and catchment geology

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Abstract

In five small lowlands streams habitat development has been studied since February 2004. The five streams have contrasting hydrologic regimes, riparian landuse and catchment geology. In all five streams 15 randomly placed transects in three study reaches have been surveyed every two months. The stream level was measured every 25 cm across the wetted width and the substratum and coverage of macrophytes has been characterised. The current velocity 5 cm above the stream bed has been measured along with the deposition of fine particulate organic matter (POM).

The hydrologic regime has been characterized by determining discharge from water level measurements collected continuously by dataloggers. Sediment transport has been studied by measuring bed load transport and transport of suspended sediment. The organic content and clay content in the transported sediment will also be analysed.

The measurements of stream bed elevation enabled calculation of stream bed stability at each point throughout the study period. Using the physical measurements four different habitat types have been identified. (1) Unstable sand, (2) Deposition of POM, (3) Stable – gravel, (4) Intermediate stable sand/gravel. In each habitat macroinvertebrates have been sampled and community characteristics and functional aspects have been analysed. Electrofishing has been used to quantify trout community structure in streams with contrasting stability. Stable isotopes (\(^{15}\)N and \(^{13}\)C) and analysis of fish guts has been used to characterise food web structure in the streams with different stream bed stability.
Sediment geochemical controls on in-stream phosphorus concentrations during baseflow

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Abstract

The interaction of phosphorus (P) with streambed sediments is a key process governing concentrations of soluble phosphorus in surface water systems. In catchments where P concentrations are elevated due to anthropogenic emissions from point or diffuse sources, sediments often act as a sink for streamwater P. The extent to which in-stream P is fixed by bed sediments is controlled by the geochemical properties of the bed sediment and surface water composition. An extensive geochemical data set of chemical composition of stream water and bed sediments of the Tamar catchment in the south west UK was examined to identify the key bed sediment geochemical properties that control the in-stream soluble P concentrations (TP (<0.45 μm)) at the catchment scale during baseflow conditions. Linear regression analysis between the P distribution coefficient and sediment geochemical properties shows that the distribution coefficient is positively correlated with K2O and negatively correlated with SiO2, which indicates that stream water TP (<0.45) concentration is mainly controlled by adsorption to clay minerals. At TP (<0.45) concentrations between 0.05 and 0.2 mg L⁻¹, the distribution coefficient is also positively related to the sediment CaO concentration, which suggests that the stream water TP (<0.45) concentration is also controlled by chemical precipitation of calcium phosphate. For TP (<0.45) concentrations greater than 0.2 mg L⁻¹, the distribution coefficient does not significantly relate to any of the sediment geochemical properties. In these cases, the TP (<0.45) concentrations are probably largely determined by nearby point source emissions and are not in or near equilibrium with the streambed sediment.
Phosphorus release from sediment in a small eutrophic Italian lake

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Abstract

Phosphorous release from the sediments of a small peri-alpine eutrophic lake (Sirio lake, NW Italy) was investigated. Measurements have been carried both on water and on sediments. The total phosphorus (TP) concentration in water after winter mixing was about 70 mg l⁻¹, with almost homogeneous vertical distribution. During the stratification period the TP concentrations at the water-sediment interface strongly increased because of release from sediments, and reaches 360 mg l⁻¹ in autumn. P diffusion resulted in a strong upwards migration of dissolved P. From the vertical profiles measured before the winter mixing, a P release rate of about 3 g m⁻²y⁻¹ was calculated, a very high value when compared with alert thresholds (about 0.5 g m⁻²y⁻¹ given in literature). Sediment cores were collected at different depths to assess the TP amount and its form variability. Information about chemical speciation is necessary to identify the P forms more likely to be released. The protocol recently proposed by Ruban et al. has been applied. This procedure allowed us to assess: organic P, Ca-bound P, Al-Fe-Mn bound P. P concentrations in sediments showed high variability: four sediment cores sampled at 20 m depth contain less then 2000 mg/kg of TP with no appreciable vertical trend, whereas the four cores from the deepest sediments (46 m) display values ranging from 2000 to 4000 mg/kg at the interface, with strong maxima up to 16000 mg/kg at about 1 meter beneath the interface. The main chemical form was Al-Fe-Mn bound P (about 90 % in the high P cores). In conclusion phosphorus release from bottom sediments was the most important source of nutrient for this lake. Whether the strong P enrichment in the sediment might be the result of natural processes or a past anthropic input is still an open question.
Wildfire Effects on the Quality and Quantity of Suspended and Gravel Stored Sediments

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Abstract

In August of 2003 a severe wildfire burned the majority of Fishtrap Creek, a 135 km² catchment in central British Columbia, Canada. The objective of this study was to evaluate the effects of the wildfire on the amount and quality of fine sediment delivery and retention in the system and to compare it to a similar unburned catchment. In the spring of 2004 automatic water samplers were installed at a gauging site near the mouth of Fishtrap Creek to collect suspended sediments from the snowmelt runoff. As well gravel traps were deployed on the channel bed surface to collect composite samples of suspended fine sediment. Jamison, the reference creek, located approximately 15 km away exhibits similar geology and pre-burn vegetation and was sampled in the same manner for comparison. Composite suspended sediment samples were removed from the streams at three times: following spring melt, in midsummer and in early September. This sample retrieval also involved a quantitative estimate of the amount and particle size structure of the naturally stored fine sediment in the gravel creekbed. The quantity, particle size structure and as well as the quality, as determined by C:N ratios was determined from the composite suspended sediment samples. The concentration of suspended sediment carried by the burnt system was found to be higher during spring melt but not during all summer rainstorm events, indicating a more complex response to precipitation events once vegetation re-growth had begun. Large local variability in the amount of gravel stored fine sediment was observed in both catchments temporally and spatially. XRD, C:N, and particle size structure of the stored sediment is currently being completed to allow a characterization of the sediment in the burnt and unburned systems and to identify differences in sediment quality.
Recent changes in sediment transport along the Penarth coast, Wales, UK

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Abstract

Recent changes along the length of the Penarth coast, South Wales have been characterized by loss of beach material, comprising limestone cobbles, and exposure of the marl bedrock. In 1997/98 beach levels dropped to a critical level and sea defences needed strengthening. There had also been an increased incidence of flooding along the main promenade and it appeared that major changes had occurred between 1995 and 1997. This coincided with the completion of two key stages in the construction of the Cardiff Bay Barrage and consequently, this structure became linked with the erosion of the beach. In addition, other anthropogenic activities, such as offshore marine aggregate dredging, were considered as possible causes of the beach erosion. A five-year study into sediment transport and beach erosion along 1.5 km of the Penarth shoreline commenced in September 1997. Quantitative and verifiable evidence of a north to south longshore drift coincided with initial concerns of erosion on Penarth beach. Losses of up to 3 t m$^{-2}$ from the foreshore were documented in a southerly direction. Subsequently, by September 2002 there was again quantitative and verifiable evidence of a return to the traditionally accepted south to north longshore transport. As extreme sea levels and wind direction are important in beach formation processes, it was shown that significant differences in mean annual extreme sea levels and wind direction coincided with major changes on the Penarth foreshore, including beach loss and change in direction of longshore drift ($t = 3.305$; df $= 8$, $P < 0.05$). Therefore it is argued that the changes at Penarth were as a result of components of meteorological origin rather than attributable to the building of the Cardiff Bay Barrage.
PCBs in surficial sediments from selected aquatic environments of the Metropolitan Zone of Mexico City and the coastal states of Oaxaca, Chiapas, Sinaloa and Veracruz (Mexico)

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Abstract

Although persistent organic pollutants have been recognized as dangerous for both the environment and human health, the data available for Mexico are surprisingly scarce. We collected surficial sediment samples from a number of important aquatic environments: (1) lacustrine sediments from lakes Texcoco, Chalco and Espejo de los Lirios in the Metropolitan Zone of Mexico City; estuarine sediments from (2) the Culiacan river in the State of Sinaloa, which is a river that conducts the sewage of Culiacan City and the agricultural wastes from the Culiacan valley to the sea; marine sediments from (3) the Gulf of Tehuantepec (facing the States of Chiapas and Oaxaca) and (4) the Gulf of Mexico (facing the State of Veracruz), both areas in which fisheries and oil exploitation (including production, refining, and distribution of oil and natural gas) are the preponderant economic activities. Samples were analysed for PCBs using an established GC-HRMS method. Total concentrations are reported as the sum of congeners. The different environments are contrasted on the basis of PCB concentrations and mixture compositions. The sources are tentatively identified as well as the potential danger for the environment.

Abstract
Sediment source changes: their effect on pollen assemblages in lake sediments

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Abstract

Intrinsic to the accuracy and precision of palynological studies is the determination of the origin of the preserved pollen. Numerous models have been produced in order to assess the relative contribution of the various airborne components to fossil pollen communities. However, Pennington (1979) identified that in open lake systems the contribution of streamborne pollen to benthic sediments is significant, representing between 85-93 % of the preserved pollen community. Despite this, little research has attempted to examine the contribution of pollen to benthic sediments; this research aims to partially redress this gap.

Results of a fine resolution $^{210}$Pb and S.C.P. dated pollen sequence are presented from Kyre Pool, Worcestershire, UK, encompassing 419 years of environmental change. Changes within the pollen diagram are correlated with possible changes in sediment source in order to assess the potential importance of the delivery of secondary pollen through hydrological pathways to palaeoecological interpretation.

The importance of the role of changing sediment delivery to lake systems is significant and should be regarded as an important taphonomic process.
Sediment sources in an urban watershed in south Brazil

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Abstract

Urban development in the metropolitan area of Porto Alegre, in south Brazil, has caused an increase in the annual sediment yield and contributed to flooding and diminished water quality. A sediment study has been carried out in a small urban catchment (3.0 km\textsuperscript{2}) to determine the relative effects of urbanization on sediment supply, delivery and deposition. Evaluation techniques have included a field survey, weekly measurement of section topography, geoprocessing satellite images and hydrological monitoring for sediment parameters such as suspension and bed load discharges. Results have shown the main sources of sediment to be erosion of channel-banks and unpaved road-surfaces. On unpaved road-surfaces, the predominant process is rill erosion. Channel-bank erosion is caused primarily by the degradation of riparian zones through irregular land occupation (squatting) and deforestation.
Using fallout lead-210 measurements to estimate soil erosion in three small catchments in Southern Italy

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Abstract

Soil erosion and associated off-site environmental impacts have attracted increasing attention over the past decades, and emphasized the need to obtain reliable information on rates of soil loss. The potential for using nuclear weapon-produced \textsuperscript{137}Cs (half-life 30.2 years) fallout to quantify rates and patterns of soil redistribution by sheet and rill erosion over medium-term timescales (ca. 50 years) has been successfully demonstrated in a wide range of environments around the world. There are, however, some important limitations to the \textsuperscript{137}Cs technique especially in areas where significant amount of Chernobyl-derived fallout was received or where the levels of bomb-derived \textsuperscript{137}Cs fallout have been low. The similar behaviour of fallout \textsuperscript{210}Pb in soils to \textsuperscript{137}Cs makes it an alternative to \textsuperscript{137}Cs in soil erosion investigations in areas where \textsuperscript{137}Cs measurements prove to be inapplicable.

This paper reports an attempt to explore the potential for using fallout \textsuperscript{210}Pb to estimate rates of water-induced soil erosion on uncultivated lands. It is based on three small forest/rangeland catchments (1.47, 1.38, and 1.65 ha) located in Calabria, Southern Italy, for which measurements of sediment output are available for the catchment outlet. The comparison between the estimates of net soil loss from the catchments derived from \textsuperscript{210}Pb measurements with the measured sediment output, confirmed the potential for using fallout \textsuperscript{210}Pb measurements to estimate rates and patterns of water-induced soil erosion on uncultivated lands. The rates of soil redistribution established for the study catchments were also consistent with existing understanding of soil loss based on \textsuperscript{137}Cs measurements undertaken over the same study areas, confirming the general correspondence between the two techniques.
Macrobenthos and environmental characteristics in the Venice Lagoon

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Abstract

The Venice Lagoon is a complex aquatic system characterised by a large heterogeneity of its environmental features due to both anthropogenic influences and natural processes. In such a system, it is interesting to assess composition and distribution of benthic fauna in different areas, four of which were chosen for this study. In February-March 1992 box cores were collected at sixteen lagoon sites, four for each area. Sediment samples were analysed for the main constituents, trace metals, organic carbon, grain size and mineralogy. The composition of benthic communities was determined and polychetes, crustaceans (principally amphipods) and molluscs turned out to be the most represented groups. In the Cona mud flat, which is directly influenced by the Dese River, polychetes are represented by a few superficial detritivores (Streblospio shrubsolii and Polydora ciliata) and by the burrower Hediste diversicolor. At Campalto the same species were found, plus the polychaete Capitella capitata, and larvae of Chironomus salinarius that are particularly abundant, especially close to the mainland. In the Giudecca area, close to the town of Venice, the benthic fauna is dominated by opportunistic species such as Malacoceros fuliginosus, Polydora ciliata e Capitella capitata, together with Hediste diversicolor. Among the molluscs we found Abral ovata and Cerastoderma glaucum. Typically marine species such as the polychetes Armandia cirrosa, A. poliophtalma, Prionospio malmgreni, P. cirrifer, Clymenura clipeata, and the molluscs Liripes lacteus and Tricola pullus prevail in the area of San Pietro The distribution of benthic fauna is discussed on the basis of sediment composition, hydrodynamics and water characteristics.
Cyclic Variations in Conductivity and Chloride in a Freshwater Coastal Lagoon, Slapton Ley, Southwest England

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Abstract

Slapton Ley is a freshwater coastal lagoon separated from the sea by an elevated shingle barrier ~4m above the Ley surface water level which lies within ~1m of local Ordnance Datum.

Short-term cyclic variations in conductivity and Cl\(^-\) were first observed in the Ley during automated high frequency water quality monitoring over three days in March 1999, four days in July 1999 and four days in April 2000. All time series appeared to relate to the local tidal regime.

Using Cl\(^-\) as a salt-water indicator, experiments were designed to establish the source of this saline water. Four spatial sampling and flow monitoring surveys over high, half and low tide series were conducted. The initial spatial survey showed that the Ley is not well mixed and that catchment runoff did not contribute a significant amount of saline water to the Ley. This survey also showed that there was a significant increase in flow over the outfall at high tide that could not be derived from measured inputs. A mass balance calculation has shown that a seawater influx of 7.84 l s\(^{-1}\) would be required to raise the Cl\(^-\) concentration in the Ley by the amount observed.

Three competing hypotheses were tested to establish a marine source for the increased salinity in the Ley over a tidal cycle and to establish the exact mechanism by which this water enters the Ley. Preliminary conclusions suggest that deep saline groundwater does not exist in the catchment and that the barrier does not leak at a sufficient rate to allow salt-water incursion. Results from the analysis of interstitial waters in sediments at over 3 m depth in the Ley suggests that seawater is forced through these layers on a rising tidal cycle and passes up through the overlying gyttja to the water column above.
The impact of lake-level fluctuations on sediment dynamics

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Abstract

In order to interpret a sedimentary record for reconstruction of natural and human induced impacts and compilation of matter flow balances in a lake, hydrology, the processes in the water column and at the sediment-water interface have to be well understood. Water level fluctuations very often have the most essential impact on the development of the lake ecosystem and especially on its trophic state. Fluctuations of water levels alter the lake morphometry and transform the characteristics of the sedimentation zones (erosion, transportation, accumulation; Hansson, 1977) of the lake bed, thereby directly influencing sedimentation, resuspension as well as biogeochemical dynamics in the lake. The stability of the deposited material depends on its granulometric and lithological structure and on the binding and frictional force between particles, which has to be higher than the gravitational force for the sediment to stay on slopes with different angles.

The main aim of this study was to establish water level changes based on the relationships between the lithological and geochemical composition of sediments and to explain the spatial-temporal regularities of the lacustrine sedimentation process. For that we studied the lithological composition of surface sediments and short cores from some small Estonian lakes and compared the data with historical evidence about lake-level fluctuations. The study of seston fluxes, short-core palaeolimnological investigation and statistical treatment of data about the granulometric and lithological composition of sediments, and their comprehensive analysis with bottom topography, showed that marginal areas were more sensitive to water-level changes. In areas with steep underwater slopes, lake-level fluctuations are reflected mainly as changes in mineral matter concentrations and in areas with flat topography the fluctuation are shown by the development of littoral vegetation. As our multi-proxy data demonstrate, lake-level fluctuations have an extremely important impact on the ecosystem on the medium-term (ca 10^3 years) scale.

Abstract
Inland freshwater ecosystem - degree and divergence of deposits that impeded in the way of development and socio-economics of Indian Sub-continent

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Abstract

Inland wetlands comprises of 25-30% that intersected with main river system (The Ganges, Brahmaputra, Padma, Mahanadi, Mahananda etc.) and it’s so many tributaries like oxbow lakes (mauns, chaur, jheels, beels, nayanjali - as they are called locally), mostly dominated in the north-eastern part of Indian sub-continent. These are immense valuable, useful for fish-aquatic crop diversity, preserved carboniferous environment of the ecosystem as sources, sinks and transformers of a multitude of chemical, biological and genetic materials, which served as ‘natures kidney’ and ultimately sustained economic stability to millions of people in the regions. Prolong sedimentation in the main rivers and tributaries in inland freshwater ecosystems over a period of time resulted formation of numbers of chaur or diura lands (islands) of different forms resulted rising of river bed, in contrary lowered the intaking capacity of runoff water during peak rainy months, causing flood making them swampy of different forms and almost turns to out of normal cultivation. Case studies along the run of main river system (The Ganges) and its 5 tributaries (Ajoy, Mayurakshi, Damodar, Kansbat and Churni) under 3 agro-climatic zones (Red & Laterite, New and Old Alluvial zone) were undertaken on nature and forms of sedimentation including physico-chemical and biological characteristics of deposits in the regions. It reveals from the study, the physico-chemical properties of embanked soils (water circulation, depletion of oxygen, H₂S generation, pH, organic C, organic matter, available N, P and K) and water as well as its biological activity (increment of sulfate-reducing bacteria, parasites) were remarkably influenced which reflected the socio-economic viability of fish-farm families who are inextricably linked with the system. It varied to a great extent possibly due to degree & deposition of sludge garbage including accumulation of feed scraps & fish feces and obviously its parent materials. In a small-scale physical removal of sediment deposits, locationwise, which promoted decomposition of organic wastes, activation of beneficial bacteria by suppressing the activity of sulfate-reducing bacteria. From the study it may be concluded that it is thus imperative to utilize this vast wetland ecosystem through improvement by some mechanical means (dredging, spreading and scooping etc.) which may serve for mankind’s safely, particularly in the north-eastern part of the country with impetuously for fish, aquatic food crops, livelihood, engagement of household labours and ultimately, economic stability of rural people as well.
Sediment as a source of internal loading of bio-available nutrients in Ben Chifley Reservoir, Australia

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Abstract

Ben Chifley Reservoir like many other inland Australian reservoirs has been experiencing chronic cyanobacterial bloom problem since 1991. Cell counts (dominated mainly by Anabaena and Microcystis) averaged more than 15000 cells mL⁻¹ during summer (December – February) and autumn (March – May), when the external inputs of nutrients from the catchment are decreased due to the absence of river flow. Therefore, laboratory core incubation and sediment peeper experiments were conducted during February, March, April and December, 2000 to determine the extent of sediment as a potential source of internal loading of bio-available nutrients to the reservoir. Consequently, different physico-chemical factors that regulate the internal loading process in the reservoir were also addressed. During cyanobacterial growth when oxygen depletion along with thermal stratification was observed in the bottom water, sediment was found a potential source of filterable reactive phosphorus (FRP) and ammonium nitrogen (NH₄⁺-N). The average flux of FRP and NH₄⁺-N through convection process was estimated to be 2 and 29 mg m⁻² d⁻¹ respectively, which was nearly equivalent to the flux through diffusion process measured from the sediment peeper experiment. It was also estimated that, the magnitude of internal loading during February and December 2000 was 2-100 times higher than the external loading of bio-available phosphorus.
Influence of evapotranspiration on water mineralization in eolian sediments

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Abstract

The influence of groundwater depth (depth of the first aquifer) to evapotranspiration as well as the influence of groundwater mineralization to soil degradation are analyzed in this paper. These investigations are related to the Northern Banat region in Vojvodina Province. The groundwater regime in this area is influenced by climatic factors mostly, then hydrological and anthropogenic factors. The influence of climatic factors is characterized by vertical water balance factors of the zone above the first aquifer. The influence of groundwater depth on evapotranspiration is analyzed separately. Groundwater levels recorded at chosen observation wells are analyzed in order to determine the part played by groundwater in total evapotranspiration. The locations of the observation wells were determined by soil types chosen. The average annual groundwater level above the critical depth has a big influence on soil degradation. This usually occurs when groundwaters are mineralized and accumulate in the alevrite clayey zone above the first aquifer. In this case the contribution of groundwater to evapotranspiration is higher.
Mineralization of Phaeocystis sp. derived phytodetritus in intertidal permeable sediment

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Abstract

In the Eastern English Channel, high biomass algal bloom of the prymnesiophyceae Phaeocystis sp. (reaching biomass higher than 20 μg Chl.a.ml$^{-1}$) is a recurrent spring events. Part of Phaeocystis-derived organic matter is degraded in sandy permeable sediments that account for a major part of intertidal area. Such non-cohesive environments are increasingly recognized as major areas in the biogeochemical functioning of coastal, estuarine and riverine systems, and they are fundamentally different from the fine-grained muds upon which most studies of sediment-water column interactions are based.

In this frame, we have measured Sediment Oxygen Demand, benthic fluxes of dissolved inorganic nitrogen, dissolved silicate and phosphates of an exposed sandy beach (Wimereux, France) using whole-core incubation technique. We have also analyzed sediment characteristics, macrofauna distribution, bacterial biomass and organic matter contents. This survey performed twice a month over a period of one year provides a basis for describing the temporal variability of biogeochemical reactions at the water-sediment interface.

Sediment Oxygen Demand remains relatively low during the whole survey (64 to 302 μmol.m$^{-2}$.h$^{-1}$) indicating limited mineralization processes. However one notes a temporal variability of fluxes with a sharp increase by a factor 5 in spring, concomitant with the deposit of Phaeocystis-derived phytodétritus. Organic Carbon contents as well as bacterial biomass show a similar variations pattern. The exchanges of dissolved compounds at the water/sediment interface are approached in terms of budget for organic matter recycling and nutrients release to the water column. Finally we discuss the consequence of the different transport processes and biogeochemical reactions in an ecological context marked by a strong algal bloom dominated by the prymnesiophyceae Phaeocystis sp.
Understanding and modeling redox reactions in carbon limited sediments

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Abstract

Diagenetic sediment processes have been well described and modelled in marine systems carbon is considered to be replete. Diagenesis in freshwater sediments are less well studied and while conceptual models of the ecological redox sequence are widely accepted, there have been few validation studies. Again, the few modeling studies conducted in freshwater sediments have assumed that carbon supply is in excess. However there are an increasing number of examples in the literature of systems where the availability of labile carbon is limiting respiration, either due to very rapid uptake rates or due to lack of inorganic and organic carbon sources to the surface waters. We present a numerical model for sediment diagenesis in which respiration (both aerobic and anaerobic) is treated as a second order process – ie we assume that labile carbon is one of the controls on the reaction. The numerical model has been validated against an analytical solution, and finally against laboratory batch experiments. In these experiments, known quantities of labile and refractory carbon were added to a stirred sediment slurry, and the rate of production of respiration bi-products monitored over several weeks. The aerobic and anaerobic respiration rate constants determined by the laboratory experiments were utilized in the diagenesis numerical model. The model was then inserted into an the Computational Aquatic Ecological DYnamics Model (CAEDYM) which, amongst other processes, allows tracking of carbon fluxes to the sediment surface. This extended version of CAEDYM has been tested in mining lakes, as an example of carbon limited ecosystems, and the preliminary results of this testing will be presented.
A comparison of conventional and microwave assisted sequential extraction methods for Cu, Pb and Zn in estuarine sediments

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Abstract

Sequential extractions (SE) are valuable analytical tools and are commonly used to gain further insight into metal mobility and availability, to identify anthropogenic inputs and to differentiate between sediments with similar bulk chemistry. However, the benefits of sequential extractions are often outweighed by a number of well-documented constraints, including the long time associated with sample preparation and analysis.

Here, two commonly used SE procedures, Tessier and BCR, have been modified using microwave extraction and compared in terms of extraction time, reproducibility and recovery. Zinc, Cu, and Pb in resulting extracts were analysed by AAS. Two CRMs (LGC6137, GBW07310) and replicate estuarine samples were used for the extractions.

Both the Tessier and the BCR microwave methods were completed in 2 days (including the digestion of a residual fraction), reducing the time required for extraction by 3 days. Data from SEs were then compared to ‘total’ metal concentrations obtained using a microwave assisted Aqua Regia digestion. In general, the microwave assisted techniques extract higher concentrations of Cu, Pb and Zn when compared to the Aqua Regia digestions. This is particularly noticeable for Cu where extraction efficiency increases from 70 % to 101 % for the Tessier method. Improved recovery rates are less significant for Pb. This may be due to variation in the partitioning behaviour of Cu and Pb in the reference materials. Here, Pb is principally partitioned to the Fe/Mn oxide fraction, while Cu is partitioned to the organic/sulphide fraction. Precision between replicate samples is generally poor for SE procedures and here %RSDs <20% for both the conventional and microwave-assisted techniques are comparable with other published work. There does not appear to be a significant decrease in reproducibility between the conventional and microwave-assisted techniques.
In-stream changes in the composition of fine fluvial sediment and their implications for sediment-associated pesticide transport in lowland permeable catchments

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Abstract

This paper examines the interactions between sediment and pesticides within contrasting permeable lowland catchments selected for research within the NERC-LOCAR thematic programme. These groundwater-fed river systems have a high base flow component and are characterised by channel reaches seasonally dominated by submerged macrophytes. In recent years they have suffered from a range of sediment-related problems, which provide a focus for current research on their fine sediment budgets. In view of the wide range of background data being collected, these catchments offer a valuable opportunity to investigate sediment-associated pesticide transport. Previous research suggests that in-stream changes in the properties of eroded soil can modify the composition of organic matter, resulting in higher organic carbon normalised sorption coefficient (Koc) values for organic contaminants sorbed to sediment when compared to soils (KILE ET AL., 1995; KILE ET AL., 1999; Koelmans ET AL., 1997). KOELMANS ET AL. (1995) demonstrated that autochthonous inputs can also increase the Koc of a compound as algal biomass decays and the polarity of sediment decreases. This modification of the organic matter of sediment over time has important implications for the frequent assumption that Koc is a constant value for each organic contaminant across a range of different environmental sorbents. The objectives of this paper are threefold. First, to establish if there is a difference in Koc between soil, bed and suspended sediment in, and between, the selected catchments. Secondly, to characterise soil, bed and suspended sediment organic matter in terms of a polarity index and organic matter functional groups. Finally, to outline the implications of the findings of this work for the assessment of pesticide loads for use in assessing catchment vulnerability to pesticide transport.
Significance of floods in the transfer of suspended matter and associated radioactivity from the Rhône River towards the Mediterranean Sea

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Abstract

The Rhône River drained for 50 years different sources of radioactive contamination (industrial releases, the Chernobyl accident, global fallout from the atmospheric nuclear tests).

Since the drastic decrease of the Marcoule nuclear plant releases in the 1990’s, artificial radioactivity from the global fallout accumulated on the river catchments as well as from the Marcoule releases trapped in sediment may represent a non-negligible source term of radioactive contamination of the Rhône River, especially by their removal during flood events. In order to quantify the fluxes towards the Mediterranean Sea and the origin of radioactivity during floods, a suspended matter monitoring was set up on the Rhône River downstream all the rhodanian nuclear plants (in Arles). The artificial radionuclide \(^{137}\text{Cs}\) and the plutonium isotopes ratios \(^{239,240}\text{Pu}/^{239,240}\text{Pu}\) were used as tracers of the particulate matter and allowed to determine the contribution and the origin of the removed radioactivity during flood.

The monitoring results underlined the significance of floods in the transfer of suspended material and associated radioactivity. The exceptional flood events of the autumn 2002 (27 days) exported about 90\% of the annual flux of suspended material, and 111±9 GBq of \(^{137}\text{Cs}\) for an annual flux of 173±22 GBq.

The \(^{239,240}\text{Pu}/^{239,240}\text{Pu}\) ratios measured during floods are significantly higher than the global fallout ratio of 0.03. This demonstrates a removal of sediment contaminated by some Marcoule releases with a ratio of 0.3. Furthermore, the particulate activities of \(^{137}\text{Cs}\) range from 10 to 20 Bq.kg\(^{-1}\) and are relatively constant. This range is similar to the \(^{137}\text{Cs}\) activities measured out of flood event downstream the Marcoule nuclear plant and seems to feature the watershed soils leaching. Thus the particulate material removed during floods originates mainly from the watershed soil leaching despite the contribution of the sediment stocks removal with associated radioactivity from Marcoule.
Heavy metal flux from eroding peatland catchments in the Peak District, southern Pennines, UK

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Abstract

The peatlands of the Peak District, southern Pennines, UK, are situated in the heartland of the 19th century English Industrial Revolution, between the cities of Manchester and Sheffield. Consequently, high concentrations of industrially-derived, atmospherically-transported heavy metals are stored in the upper peat layer (typically in excess of 1000 mg kg⁻¹ for Pb). The peat catchments of the Peak District are unquestionably the most eroded in Britain and erosion of the contaminated upper peat layer could potentially release heavy metals, associated with eroded peat particles, into the fluvial systems of the region. To test this hypothesis, storm water samples were collected over a two year period from two eroding peatland catchments in the Peak District. Stormflow sediment-associated Pb concentrations are highly variable over space and time, influenced by a combination of geomorphological, hydrological and physico-chemical conditions of the catchment. Pb concentrations in suspended sediment commonly exceed 100 mg kg⁻¹ and peak values exceed 350 mg kg⁻¹. During stormflow events in the Peak District, stream water pH can fall as low as pH ~ 3, as natural organic acids and industrially-derived acid species are flushed out of the upper peat layer by throughflow. Such acidic stream water conditions may result in desorption of heavy metals from contaminated peat particles into the water column. Experimental evidence shows that this can occur, however, a strong positive correlation between dissolved Pb and DOC concentrations in the study streams, suggests that dissolved Pb in stream water is primarily derived from in-situ release of dissolved Pb from the contaminated upper peat layer. Many headwater steams of the Peak District recharge drinking water reservoirs. The legacy of the 19th century English Industrial Revolution is affecting the quality of sediment and water entering reservoirs of the region.
Some results of direct measurements of chemical exchange through the bottom-sediment interface

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Abstract

Benthic chamber method was used for direct measurements of chemical fluxes in the sediments of the northeastern coastal part of the Black Sea. Three boxes were installed on the bottom simultaneously to estimate total fluxes (working box), bottom water processes (background box) and influence of Diffusion Bottom Layer – DBL (hydroquinone box). Stirring inside the boxes was run with the outer fan through the magnet system. Sampling from the boxes was performed by divers with syringes. Analyses (oxygen, nutrients, and metals) were made immediately in the coastal lab.

Oxygen consumption (CO₂) by benthos was estimated by formula CO₂ = AxB⁰.²⁵ x N⁰.⁷⁵ where A – a constant for the kind, B – biomass, N – number of organisms. Comparison with total oxygen consumption (working box) shows that at least 10 % of O₂ in oxic sediments is consumed by macro benthos.

Nutrient fluxes are not very regular and can be directed both into and out of the sediment. Occurrence of an oxic layer (or a film), enriched by iron hydroxide on the surface of the sediment is very important. This film absorbs phosphate from the bottom water directing the phosphate flux into the sediment. As O₂ decreases in the boxes, the oxic layer disappears and the phosphate fluxes change their direction enriching bottom water. Dissolved silica fluxes depend on the silica content in bottom water. In the area of river discharge at the high content of dissolved and suspended silica in water the SiO₂ fluxes are directed into the sediment. Usually in the deposits at distance of rivers, dissolved SiO₂ fluxes are directed from the sediment into the bottom water due to dissolution of amorphous biogenic and clastic debris.

Behavior of metals (Fe and Mn) depends both on the O₂ content in the bottom water and the occurrence of oxic layer at the water-sediment interface. When the oxic layer disappears, the Mn and Fe fluxes from the sediment increase. O₂ consumption by benthic animals, as well as in oxidation of organic matter and inorganic forms (Mn²⁺, Fe²⁺, and S²⁻) leads to hypoxia and anoxia in the sediment and in bottom water appears H₂S. During H₂S oxidation, S⁰ and S₂O₃²⁻ are formed in bottom water. A valuable change of chemical composition takes place in the bottom water even when it is isolated from the sediment (background box). Therefore the total fluxes through water-sediment interface should be corrected. According to our data the share of the O₂ changes in coastal bottom water against the total O₂ consumption by the sediment amounts 5 - 20 %. It is known that the thickness of DBL and the values of fluxes through the water-sediment interface depend on the values of currents. Correlations between the rates of dissolution of hydroquinone casts installed inside and outside (hydroquinone box) give an opportunity to estimate the differences in hydrodynamics and in values of fluxes. Very high stirring velocities in the boxes lead to disappearance of DBL and distort results.
Recent sedimentary history of organic matter and nutrient accumulation in the Ohuira Lagoon, northwestern Mexico

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Abstract

The Ohuira lagoon is a coastal transition area located in the Gulf of California. It supports an important artisan fishing activity of penaeid shrimps that are mainly exported to the USA market. However, the surrounding land is subject to intensive and technified agriculture and several effluents drain into the lagoon, causing the constant introduction of nutrients and pollutants to the site. $^{210}$Pb-derived sediment accumulation rates, as well as the organic carbon concentrations and total content of phosphorus and nitrogen in the sedimentary column of the Ohuira Lagoon, were used to assess the time dependent changes in nutrients fluxes and to evaluate their relationship with the population growth and the economical development of the region. The relative importance of allochthonous and autochthonous sources of organic matter was evaluated through C/N ratios and $\delta^{13}$C values.
A Prospective Binding Gel of DGT Technique for Measuring Filterable Organic Phosphorus from Sediment Pore and Overlying Waters

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Abstract

Filterable organic phosphates (FOP) are an important component of the aquatic phosphorus cycle, and on hydrolysis, may comprise a significant source of bioavailable phosphorus. An established DGT technique with ferric oxide binding gel has been developed as an in situ technique for accumulating orthophosphate from overlying water\(^1\) but has not been used to accumulate FOP. The aim of this research is to develop a DGT binding gel to accumulate FOP from sediment pore and overlying waters. Lanthanum hydroxide paste has been chosen as the binding agent of the gel because of its affinity for organic phosphorus and its diamagnetic properties that will not give interference when using \(^{31}\)P-NMR for P characterization. FOP adsorbed onto the La(OH)\(_3\) binding gel was eluted with 10 ml of 0.05 M sulfuric acid, and the FOP concentration was measured using online photo-oxidation FIA\(^2\) methods, based on the formation of phosphomolybdate blue complex. The milky white gel of La(OH)\(_3\) binding gel has been successfully developed from the mixture of La(OH)\(_3\) paste and gel solution that consists of DGT cross linker and acrylamide solution. This gel was fully hydrated and dimensionally stable after 3 hours in MQ water of storing solution. The weight-increasing factor of this gel was around 1.3 when immersing in the solution with pH 4.0-5.3 for 3 hours. Around 90 % of organic-P model compounds could be adsorbed onto the gel. The recovery of P eluted from the gel was around 77 %. The lower P recovery from eluted solutions may be due to interference in the oxidation of lanthanum phosphate. From our results, the La(OH)\(_3\) binding gel can be used as a DGT binding gel to accumulate FOP from the field. Suitable FOP detection techniques for use in the presence of lanthanum are currently being investigated.
