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REPORT OF THE PILOT STUDY MEETING

PREVENTION AND REMEDIATION IN SELECTED INDUSTRIAL SECTORS

Sediments

Ljubljana, Slovenia
June 17-22, 2007

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Prevention and Remediation
in Selected Industrial Sectors:
Sediments

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INTRODUCTION

The Council of the North Atlantic Treaty Organization (NATO) established the Committee on the Challenges of Modern Society (CCMS) in 1969. CCMS was charged with developing meaningful programs to share information among countries on environmental and societal issues that complement other international endeavors and to provide leadership in solving specific problems of the human environment. A fundamental precept of CCMS involves the transfer of technological and scientific solutions among nations with similar environmental challenges. More recently, CCMS merged with the NATO Science Program to form the new Science for Peace and Security (SPS) Program. This final pilot study meeting was conducted under the auspices of the SPS Program.

This document reports on the fifth and final meeting of the Pilot Study on Prevention and Remediation Issues in Selected Industrial Sectors. The purpose of the pilot study is to define and explore best practices for reducing the health and environmental impact on soil and groundwater from industrial sectors of interest (e.g., metals mining, organic chemical production, gasworks, and fertilizer manufacturing) as well as other unique site "types" (e.g., old landfills, privatization sites [i.e., facilities transitioning from former state ownership in certain categories], mega-sites [i.e., large scale former industrial and mining facilities], and shoreline sediment sites). The pilot study explored the techniques and technologies for preventing and avoiding discharge to soil and groundwater as well as measurement and remediation for that industry sector or site type. It sought to engage industry and other private sector organizations at the transnational level in sharing and evaluating technical information. In reviewing case studies as well as experience from the previous CCMS pilot study on contaminated land and other sources, the pilot study strived to assess or benchmark "what is easy to clean," "what is difficult to clean," and "what is impossible, at reasonable cost, to clean." The unique contribution of the pilot study is measured by its ability to synthesize information regarding best practices, successes and failures, and uncertainties for the sectors of interest.

The fifth meeting of the Pilot Study was held in Ljubljana, Slovenia, from June 17-22, 2007. This meeting dealt with the issues relating to sediment sites, as well as some questions of contamination by persistent organic pollutants (POPs). Nineteen technical papers fell under the broad topics of sediment characterization and sediment remediation. Thirteen countries gave Tour de Table presentations– summaries of the state of the development of waste and contaminated land programs and/or related research in their respective countries. The United States is the lead country for the Pilot Study, and 16 other countries participated in the meeting. This report is a set of abstracts of the presentations at the meeting. In addition, a CD containing all presentation materials (e.g., power point slides) from this meeting and the four previous meetings is available. CDs are available by contacting the country representatives listed at the back of this document.

This report is available online at http://www.nato.int/science and http://www.cluin.org/ljubljana. General information on the NATO/CCMS Pilot Study may be obtained from the country representatives listed at the end of the report. Further information on the presentations in this document should be obtained from the identified presenters.

Walter W. Kovalick, Jr., Ph.D.
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SEDIMENT CHARACTERIZATION

ASSESSMENT OF DRAINAGE BASIN CONTAMINATION BY STREAM AND FLOODPLAIN SEDIMENT GEOCHEMICAL SURVEYS

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1. ABSTRACT

Stream sediment is deposited on the bed of the active river channel, whereas overbank or floodplain sediment is produced when major floods occur in a river system. During such floods, the water discharge exceeds the quantity that can pass through the ordinary river channel (bankful discharge). Even in streams of moderate size, the water level may reach several metres above normal, thereby covering large areas. At these times, many new sediment sources open up, and the origin of the load suspended in the stream is manifold. Throughout the flood, and especially during its last phases, some of the stream load will be deposited on the floodplain at levels well above those of the ordinary stream channel. In this way, nearly horizontal layers of overbank sediment are successively built up over long periods of time.
Extensive research studies were carried out in many European countries on the use of active stream and overbank sediments to assess anthropogenic contamination of drainage basins. The results showed that active stream sediment is susceptible to contamination by mine wastes or other products of human origin, and is also recorded in surficial overbank sediment layers. The lowermost layers of overbank sediments, however, do provide information on pre-industrial geogenic dispersion patterns. Even in strongly contaminated areas, it is possible to find natural geochemical distribution patterns by sampling the lowermost overbank sediment layer.

Figure 1 shows the distribution of Pb in active stream sediment, which is strongly contaminated by mining and smelter wastes for a considerable distance from the industrial sources. By sampling the different layers of overbank sediment the geochemical history of the area was revealed. The first two layers have been contaminated from materials derived from the mining and smelter wastes, whereas the bottom horizons show pristine conditions. It is concluded, therefore, that the top layers of overbank together with the active stream sediment, show present day conditions, including anthropogenic contamination, wherever it exists, whilst the lowermost horizons of overbank sediment exhibit pristine or pre-industrial conditions. Therefore, the degree of contamination can be assessed by comparing element concentration values of top and bottom overbank sediment layers.

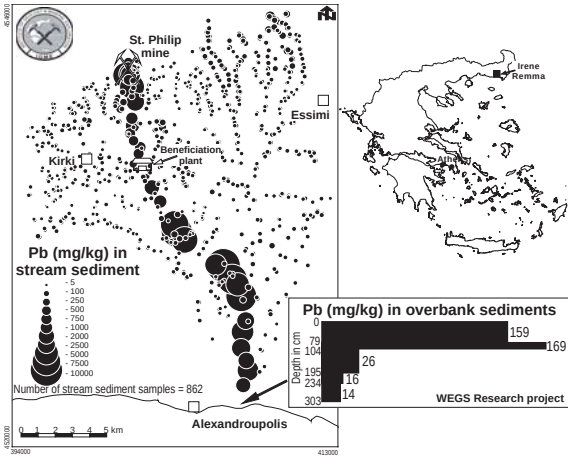

Figure 1. Distribution of Pb in active stream sediment and overbank sediments in the drainage basin of Irene Remma Thrace, N.E. Greece

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SEDIMENT REMEDIATION

AN INTEGRATED APPROACH FOR THE REMEDIATION OF A CATCHMENT IMPACTED BY FORMER MERCURY MINING

Milena Horvat, Ph.D.
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1. ABSTRACT

Introduction:
Environmental contamination by heavy metals is a phenomenon that has accompanied human activities, mainly associated with mining activities, industrial processes, energy production, manufacturing, and the disposal of domestic and industrial wastes. Several heavy metals that are naturally present in the environment at trace levels may be without discernable hazard or may even act as essential nutrients for vegetation growth. However, when present at high levels, these heavy metals can be toxic to the flora and fauna (i.e., vegetation, cattle, fishes, and humans) via the food chain (mainly through crops and seafood).

Appropriate predictions of potential future environmental impact and public exposure, and the development of adequate remedial technologies or appropriate countermeasures, require the understanding of the mechanisms ruling element mobility and behaviour in and between different environmental compartments (terrestrial, aquatic, and atmospheric). Nowadays, there is no general agreed upon approach for remediation actions in the terrestrial and aquatic ecosystems after a contamination event.

Mercury:
Mercury (Hg) is widely considered to be among the highest priority environmental pollutants of continuing concern on the global scale. In response to the increasing intensity of research dedicated to mercury on a global scale, the need to provide a forum was recognized for presentation of results, discussions, and the exchange of innovative ideas and to communicate with policy makers, legislators, experts from industry and public representatives in order to promote the direct use of scientific and technical data in the field of environmental protection and control. This is evidenced from the recommendations recently drafted by the European Union's (EU) Mercury Strategy and the United Nations Environment Programme's (UNEP) Global Mercury Assessment approved by the UNEP Governing Council in 2003.

Although there is a continuous problem of occupational exposure to inorganic Hg, predominantly elemental Hg, possible effects on broader segments of the population due to widespread dispersal of Hg in the environment has become the major concern in recent years. Mercury is among the most highly bioconcentrated trace metals in the human food chain, and many national and international agencies and organisations have targeted mercury for possible emission control. Mercury toxicity depends on its chemical form, among which alkylmercury compounds are the most toxic. The biogeochemistry of mercury has received considerable attention because of the toxicity of methylmercury compounds (MeHg), the accumulation of Hg in biota, and its biomagnification in aquatic food chains. Concerns about Hg are based on its effects both on ecosystems and human health. The principal pathway for human exposure is the consumption of contaminated fish. Numerous recent studies have concluded that the majority, if not all, of the Hg that is bioaccumulated through the food chain is as MeHg. Therefore, knowledge of the concentration, transport, transformation and dynamics of MeHg in aquatic ecosystems is needed to predict its potential impact on humans, as well as on aquatic life.

From studies already carried out in the past, and several within the framework of research projects funded by the European Commission, certain parameters have been shown to be crucial to describe the interaction of heavy metals in the environment, such as the solid-liquid distribution, soil-plant transfer, migration, resuspension, bioavailability and the remobilisable fraction. These parameters govern the

eventual fate of the contaminant in the ecosystem, thus indicating the need of a mechanistic approach based on adsorption-desorption experiments to face a potential contaminated scenario. Data on these parameters and on related indexes of metal mobility are already available. However, there is not yet a common agreement on which methods and procedures to use at the laboratory scale to better quantify these parameters and simulate the experimental conditions at the field scale. Therefore, there is also a need for high-quality data bases with values reliable enough to serve as inputs for models or environmental decision support systems, especially when results are method-dependent.

It has also been shown that a generalist approach to study mercury fate is not adequate, since safety and risk assessment methods must be based on specific criteria. Otherwise, environmental decision support systems may become useless when extrapolated to other areas than those used under their ideal conditions. The significance of considering the specific characteristics for scenarios as a result of the interaction of mercury with key components in the different case studies is a realistic approach. Although relevant information is available for a number of metals in various types of soil (largely from areas of Northern Europe), there is still a lack of knowledge for significant scenarios or for some items such as mercury-soil combinations at the European scale, data that is necessary to be included in a risk assessment methodology. An example is those ecosystems affected by Mediterranean conditions. The distinctive characteristics of the soils in this area (high carbonate and clay content; low organic matter content; dry seasons followed by potential flooding periods) require specific studies to adapt or verify conclusions derived from previous experiments performed in other environmental conditions. Other scenarios showing a lack of data should be identified and properly studied to complete mercury distribution, behaviour, and impact on a European scale.

Case study:
The presentation will address the case study in Slovenia and Northern Italy where, during the 500 years of mercury mining in Idrija, large quantities of Hg were released into the environment and caused severe contamination of soil, river and coastal sediments. Due to chemical transformation (reduction, methylation, oxidation, demethylation) and transport of mercury-enriched particles into the river system and the Gulf of Trieste, the mercury problem is of local, regional, and global concern. The results of some studies indicate that Hg is actively accumulated in terrestrial and aquatic food webs, which leads to an increased exposure of inhabitants frequently consuming food, in particular fish, produced in contaminated areas. In order to understand the impact of mercury mining on the environment and human health, it is necessary to integrate the experience of various disciplines (e.g., chemists, biologists, geologists, hydrologists, epidemiologists, and economists). Political support at the local and regional level in Slovenia and Italy is also an ultimate requirement for the successful implementation of remediation based on scientifically based criteria.

Approach:
It is generally accepted that the formation and bioaccumulation of methylmercury is the most critical point of environmental quality in mercury-contaminated sites. The reduction of methylmercury in food can therefore be defined as the priority objective with regard to the mercury-contamination problem in the wider Idrija area and in the Gulf of Trieste. To reach this target, two principal strategies exist:

(i) reducing the input of mercury to the system; and
(ii) changing the conditions to reduce the formation of methylmercury.

Due to the highly complex biogeochemistry of mercury, measurement campaigns and the development of models (riverine, atmospheric and marine transport, species transformation) are in progress in order to support an integrated model approach that will be used as a management tool and should be capable of quantifying the responses of the entire air-land-river-sea-biota system to specific measures or abatement activities and alternatives for economic development.

One of the first steps in assessing the effects of a contamination is acquiring the knowledge on the behaviour of the contaminant. In this case, mercury behaviour is determined in each environmental compartment (soil, aquatic systems and atmosphere) and the corresponding interactions between these compartments. A second step is to know how and from what level onwards the contaminant affects the environment. A third step includes the management of the contaminated area and the elaboration of a complete environmental risk assessment. Such an approach requires an interdisciplinary and intersectorial approach, which has unfortunately not been demonstrated so far.

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4) USA EPA Programme: http://www.epa.gov/mercury/

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ACTIVE CAPPING DEMONSTRATION IN THE ANACOSTIA RIVER, WASHINGTON DC

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1. ABSTRACT

The active capping demonstration project in Washington, DC, is testing the ability to place sequestering agents on contaminated sediments using conventional equipment and to evaluate their subsequent effectiveness relative to conventional passive sand caps. Selected active capping materials (AquaBlok^{TM}, a clay for permeability control, apatite, a phosphate mineral for metals control, coke, an organic sequestration agent, sand, and a control cap), were placed in 8000 ft^2 test plots during March and April 2004. Placement was by conventional clamshell except for coke, which due to concerns about settling of the material was placed as 1.25 cm layer in a laminated mat. Post-capping sampling and analysis was conducted one month, six months, and 18 months after placement. Post-cap sampling is expected to continue for at least an additional 24 months, but the current report is to summarize the results of the placement and post-cap sampling efforts up to 18 months. Conventional clamshell placement was found to be effective for placing relatively thin (6-inch) layers of active material and the viability of placing high-value or difficult-to-place material in a controlled manner was demonstrated with the laminated mat. Post-cap monitoring has found that all cap materials effectively isolated contaminants, but it has not yet proven possible to differentiate between conventional sand and active cap layer performance. Monitoring of the permeability control layer indicated effective reductions in groundwater seepage rates through the cap but also showed the potential for gas accumulation and irregular release. High resolution contaminant profiles show sediment-cap material intermixing but no discernible contaminant migration. A novel approach for in-situ measurement of porewater concentrations is being attempted in an effort to discriminate between the various caps. All caps show deposition of new contaminated sediment to the surface of the caps. Fingerprint analysis of PAHs at the top and bottom of the caps show that both sediments are effectively identical, indicating that the redistribution of adjacent sediments or continuing release from ongoing sources, and not migration from below, are the cause. The presence of new contamination on top of the caps illustrates the importance of source control in maintaining sediment quality after any type of active remediation.

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SEDIMENT BIOBARRIERS FOR CHLORINATED ALIPHATIC HYDROCARBONS IN GROUNDWATER REACHING SURFACE WATER

Ludo Diels
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1. ABSTRACT

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In the EU-project, SEDBARCAH, we are studying the intrinsic capacity of eutrophic river sediment microbial communities to degrade Chlorinated Aliphatic Hydrocarbons (CAHs). As a test case, the Bělá river in Czech Republic and the Zenne river in Belgium were chosen. For both rivers the influx zones of the CAHs were determined by sampling groundwater in boreholes and interstitial water with a specific probe. At the highest CAH influx zones, undisturbed sediment samples were taken with a piston sampler to study the structure and the catabolic potential of the microbial community. Anaerobic microcosm tests showed, for both rivers, a rapid microbial dehalogenation of all CAH compounds to non-toxic ethene. For the Zenne river, chloroethene degrading *Desulfuromonas* and *Dehalococcoides* species were present in high numbers in the sediment as shown by quantification of their 16S rRNA genes by real-time PCR. Furthermore, the detection of the vcrA and bvcA genes, which code for the VC reductive dehalogenases of respectively *Dehalococcoides* sp. strain VS and BAV1 indicates that these two *Dehalococcoides* species are probably responsible for the observed degradation of vinyl chloride (VC), the main pollutant in the Zenne. A vertical distribution of Eubacteria, iron-reducing bacteria, sulfate-reducing bacteria, and methanogenic bacteria in the polluted Zenne sediment was observed by Denaturing Gradient Gel Electrophoresis. Our results indicate that the interface between groundwater and surface water harbors a unique microbial community structure that is capable of degrading CAHs in groundwater before they reach the surface water. In this way, the sediments act as a natural biobarrier for groundwater pollutants passing through the interface, hereby reducing the risk of surface water contamination.

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REDUCTIVE BIO-MODIFICATION OF SEDIMENT CONTAMINANTS: AN *IN SITU*, MOLECULAR HYDROGEN FORMATION APPROACH

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1. ABSTRACT

Contaminated sediments represent a challenging remediation target. In aquatic systems, the potential for remobilization, in response to the remedial effort or as a consequence of the native hydrodynamic setting, precludes many traditional *in situ* methodologies. Sorption effects and low hydraulic conductivities present limitations on both *in situ* or during *ex situ* treatment. Bioremediation, primarily in the form of monitored natural attenuation, has become the default approach for remediation at many terrestrial sites but has had limited application to *in situ* sediment remediation due to concerns over nutrient delivery and containment. Yet many of the primary contaminants associated with sediments, such as chlorinated organics and some metals, are amenable to reductive biotreatment. Current approaches, used in other remedial settings, involve the production of molecular hydrogen, directly or indirectly, as a bio-available electron donor to drive the desired reductive processes. However the traditional biostimulation approaches do not appear to be appropriate for the previously mentioned reasons.

Laboratory and field experiments have been conducted on a novel approach to drive the formation of molecular hydrogen through the application of negative charges to emplaced electrodes. This approach addresses many of the unique remedial challenges presented by contaminated sediments. Some of the findings indicate a potential design for field scale applications to treat sediments in place, or as a process for batch treatment of excavated sediments.

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MANAGING CANADIAN GREAT LAKES CONTAMINATED SEDIMENT

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1. ABSTRACT

The governments of Canada and the United States have recognized contaminated sediment issues as a major problem in the Great Lakes ecosystem. In 1985, these two countries identified 43 Areas of Concern (AOC) where impaired water quality prevented full beneficial use of rivers, bays, harbours and ports.

Canada and the province of Ontario jointly developed the Canada Ontario Agreement (COA) Sediment Assessment Framework (Framework) to provide a consistent approach for assessing contaminated sediment sites within the 17 AOC in Canada. This Framework is a rule-based, weight-of-evidence approach for assessing contaminated sediment on a site-by-site basis. Information is considered from four lines of evidence: chemistry, toxicity, benthic community structure, and the potential for biomagnification (i.e., ecological and human health impact).

The Framework principles were followed in Thunder Bay Harbour. This AOC contains sediment contaminated by polycyclic aromatic hydrocarbons (PAHs), chlorophenols, dioxins, and furans around the Northern Wood Preservers site. A biological assessment study was conducted to establish site-specific clean-up criteria. Based on measured biological effects related to PAHs, three cleanup zones were identified corresponding to areas of acute toxicity, chronic toxicity, and no measurable toxicity. The most effective solution was determined to be combination sediment removal/treatment and isolation. Remediation included construction of a rockfill containment berm as well as capping of the enclosed area using clean fill. As compensation for the infilling activities, fish habitat was created in accordance with Canada's "no net loss policy." Extensive public consultation was undertaken to ensure public acceptance of the plan. This $20 Million project commenced in August 1997 and remedial work was completed in the summer of 2003.

The framework was also applied at Randle Reef (Hamilton Harbour AOC), one of Canada's most contaminated sediment sites. Proposed remediation for this site involves constructing a 9.5 hectare engineered containment facility (ECF) that will manage PAH and heavy metal contaminated sediments in two ways: (1) the ECF will be constructed on top of some of the most highly contaminated sediments (*in situ* 130,000 m^3), isolating those sediments in place; and (2) other highly contaminated sediments (500,000 m^3) will be dredged and placed inside the ECF. The engineering design for this project is underway and will be completed in the summer of 2008.

Environment Canada has contracted an independent study to quantify the economic and non-monetary benefits related to the remediation of contaminated sediments in Randle Reef. Preliminary results identify over $126 million in return on investment for this sediment cleanup project, which is estimated at $90 million.

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CONTAMINATED SEDIMENTS IN ITALY: METHODOLOGICAL APPROACHES AND STATE OF THE ART OF CHARACTERISATION AND RECLAMATION ACTIVITIES CARRIED OUT WITHIN SITES OF NATIONAL INTEREST

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1. ABSTRACT

Through several laws and decrees, the Italian Ministero dell'Ambiente e della Tutela del Territorio (Ministry of the Environment and of the Safeguard of the Territory) established a list of 53 contaminated sites defined as of "National Interest," due to their size, contamination amount and diffusion, and social and economical problems. There are 25 reclamation sites of national interest that are enclosed within perimeter coastal marine and/or brackish areas and are distributed along the whole Italian coast.

According to D.M. 468/01 ("Programma Nazionale di Bonifica e Ripristino Ambientale") (National Programme for Environmental Reclamation and Restoration) the Ministero dell'Ambiente e della Tutela del Territorio (Ministry of the Environment and of the Safeguard of the Territory) has appointed ICRAM (the National Institute for Applied Research to Marine Environment) for the characterisation of coastal marine and brackish areas included within the perimeter of "reclamation sites of national interest."

ICRAM, as a scientific Institute, has defined the criteria for a systematic approach to the problems that arise from characterising large-scale coastal and lagoon areas, which aims to determine the distribution of contaminants and to identify situations at risk in order to activate adequate interventions for emergency safety actions, reclamation and environmental restoration. Sviluppo Italia Aree Produttive S.p.A., a State Company devoted to environmental remediation and revitalization of industrial and polluted areas, has been defined as the public operator for realizing of characterization and remediation activities on polluted sediments within the perimeter of some National Interest Sites (La Spezia, Bagnoli, Priolo, Gela, Piombino). The number of sites and the volumes of contaminated sediments have required the development of management techniques in order to prioritize the use of the available resources and nevertheless guarantee limited but immediate action where high risk is present.

Currently, a clear decision framework for *in situ* sediment assessment and management is partially missing in Italy. Therefore, the result of detailed investigations should be evaluated using screening values borrowed from soil legislation or other reference studies and through the definition of case-by-case solution based on expert judgment. Recently, an approach based on the development of site-specific "Intervention Values" was developed and is being applied in several contaminated sites.

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REMOVAL STANDARDS AND CONTROL MEASURE FOR BOTTOM SEDIMENTS CONTAMINATED BY TOXIC SUBSTANCES IN JAPAN

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Japan

1. ABSTRACT

Environmental Water Quality and Effluent Standards were established in Japan in order to control water pollution caused by toxic substances. Since public water areas also hold sediments containing toxic substances that detract from water quality, release dangerous toxins and cause the bio-accumulation of toxins in fish and shellfish, these standards are not always sufficient for the protection of human health. The Ministry of the Environment (formerly Japan Environment Agency) has therefore set up the "Provisional Removal Standard" for bottom sediment that contains mercury and PCB. This procedure, based on risk assessment for mercury in bottom sediments, has been adopted for the development of a removal standard for mercury. In the case of PCB, however, an empirical relationship between PCB concentrations in bottom sediments and PCB concentrations in fish has been adopted (i.e., a provisional removal standard for bottom sediment of PCB is 10 mg PCB/kg dry sediment). In this presentation, an environmental quality standard for dioxins found in bottom sediment (150 pg-TEQ/g dry sediment) is also introduced. Furthermore, the Ministry of Land, Infrastructure, and Transport Japan organized two committees for evaluation and reviews of clean-up technologies for dioxin-contaminated river or port sediments. The essential results by two committee activities are also introduced.

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SEDNET PROJECTS

INTRODUCTION TO SEDNET

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1. ABSTRACT

The European Sediment Network (SedNet) started in 2002 as a Thematic Network with funding from the European Commission DG-Research under the 5th RTD Framework Programme. It was aimed at setting up a European network in the field of "assessment of fate and impact of contaminants in sediment and dredged material and at sustainable solutions for their management and treatment."

Since 2005, SedNet has run independently from the EC. It brings together experts from science, administration, and industry. It interacts with the various networks in Europe that operate at the national or international level and that focus on specific fields, such as science, policy making, sediment management, industry, and education.

SedNet is now the European network aimed at incorporating sediment issues and knowledge into European strategies to support the achievement of a good environmental status and to develop new tools for sediment management. The focus is on all sediment quality and quantity issues on a river-basin scale, ranging from freshwater to estuarine and marine sediments. More information can be found on www.SedNet.org.

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RISK ASSESSMENT OF CONTAMINATED SEDIMENTS IN RIVER BASINS— THEORETICAL CONSIDERATIONS AND PRAGMATIC APPROACH

Ulrich Förstner & Susanne Heise
Germany

1. ABSTRACT

Sustainable management of contaminated sites in a river requires an extensive description of the sediment, contaminant, and risk processes at river-basin scale because management activities and natural phenomena that take place on one site potentially influence other sites down and upstream. Concentrations and rates of contaminant matter and suspended matter in the main river and its tributaries during normal and flood events, resuspension areas, settlement areas need to be described. A practical approach to a basin-scale framework for risk management has been shown to comprise three levels of information: (1) characterization of the basin-specific substances of concern, which impair the basin-scale objectives, (2) the areas of concern that represent contaminant depots in a catchment, and (3) the areas of risk (mostly a subgroup of the areas of concern), from which contaminated sediments are transported downstream, degrading the quality of the river.

Two example areas are presented: (1) the Rhine catchment, where two “areas of high risk” were identified with high certainty from which contaminated sediments could be transported downstream under certain discharge conditions; and (2) the Elbe River, for which a river basin-wide sediment assessment is being carried out to perform inventories of interim depots within the catchment area (i.e. mining residues underground and at surface-level, river-dams, lock reservoirs, and flood plain and groyne field sediments). With the aim to identify areas of risks, data of suspended-particle load and contaminant loads at different locations along the Elbe are being collected and discussed. These data will help point out those sites where measures can be most effectively carried out to reduce the risk to the basin-scale objectives.

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SEDIMENT MANAGEMENT—AN ESSENTIAL ELEMENT OF RIVER BASIN MANAGEMENT PLANS

Ulrich Förstner & Susanne Heise, on behalf of SedNet (www.sednet.org)
Germany

1. ABSTRACT

On the 22nd and 23rd of November 2006, SedNet held a round-table discussion in Venice, Italy, entitled "Sediment Management–An Essential Part of River Basin Management Plans." The Round Table Discussion brought together scientists and delegates from European river commissions and user groups. The river basins represented were the Danube, Douro, Elbe, Humber and Rhine. The participants concluded that sediment management is an issue in all five river basins. Sediment management in terms of quality and quantity should receive due attention in River Basin Management Plans. To develop such a plan can be challenging, taking into consideration the requirements of different European and national legislation. An adaptive management approach is required. There is no one-size-fits-all solution; it has to be tailor-made to the specific situation. There is a need to collate available data to identify knowledge gaps and enhance understanding, linking sediment management to environmental and climate change issues.

The Round Table concluded that achieving good ecological status requires proper attention to sediment issues, with an awareness of natural variation and differences between river basins. The outcome of the Round Table will be used to inform River Basin Managers, key players and users, and the European Commission for the further implementation process of the Water Framework Directive (WFD).

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TOWARDS RISK-BASED MANAGEMENT OF THE SEDIMENT-SOIL-WATER SYSTEM AT THE RIVER BASIN SCALE (EC FP6 CA RISKBASE)

Jos Brils
The Netherlands

1. ABSTRACT

RISKBASE-leading European scientists and representatives of major European stakeholder groups are reviewing and synthesizing the outcomes of European Commission's (EC) RTD Framework Program projects, and other national initiatives, related to integrated risk assessment-based management of the water/sediment/soil system at the river-basin scale. The synthesis will lead to the development of integrated risk-based management approaches for the prevention and/or reduction of negative anthropogenic impacts on these systems.

Logically, risk is always connected to an object or area of concern and within RISKBASE, this is defined as the goods and services provided by the soil-sediment-water ecosystem, with a specific focus on the system's resilience. The Resilience Alliance network (www.resalliance.org) defines resilience as "the amount of change a system can undergo (its capacity to absorb disturbance) and remain within the same regime and retain the same function, structure, and feedbacks."

Resilience thinking may provide an interesting, innovative approach for (risk-based) management of river basins. Hence, the meaning of this concept for RISKBASE is now further explored via literature reviews, a closed preparatory/ exploration workshop (3 & 4 December, Venice, Italy), and a public conference tentatively scheduled for May 2008 in Budapest.

RISKBASE is a Coordination Action project funded by the EC under its 6th RTD Framework Programme (Contract No. 036938 GOCE). The project started at 1 September, 2006, and will end at 31 August, 2009. For more information, check out the RISKBASE website at: www.riskbase.info.

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PERSISTENT ORGANIC POLLUTANTS CONTROL

POPS REDUCTION STRATEGY IN SURFACE WATER OF INDUSTRIALIZED REGIONS—KLODNICA RIVER CASE STUDY

Janusz Krupanek
Poland

1. ABSTRACT

The new European Union legislative framework for water management established by the Water Framework Directive in the aspect of persistent pollutants requires planning and implementation of effective strategies that can be efficient in socio-economic terms. It is especially important in the regions that were under environmental impact for a long time, ending up with accumulation of pollutants in the environment. The priority substances under consideration by the new EU legislation include cadmium, lead, and mercury compounds, and selected Polycyclic Aromatic Hydrocarbons (PAHs). These substances pose an environmental problem in the industrialized Upper Silesia region, which discharges the greatest load of these substances into two major Polish rivers: Vistula and Odra. The analyses show that the most important substance of concern is mercury. The potential sources of contamination include: contaminated post-industrial sites and soil, river sediments, landfills, discharges from operating industrial facilities, and air deposition generated in the region by the energy, municipal, and heavy industrial sectors. Management of the problem requires undertaking actions within monitoring system, assessment tools and decision making procedures.

In the presentation, the overview of the situation in Poland and one of the river catchments located in the Upper Silesia region—the Kłodnica river—explains the initial hypotheses on the sources and causes of river contamination by priority substances, and initial identification of available catchment-scale management options, technical solutions, and required actions to be taken in the future.

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BEST AVAILABLE ECOLOGICAL FRIENDLY TECHNOLOGIES FOR UTILIZATION OR DESTRUCTION OF POPS IN THE RUSSIAN FEDERATION

Sergey E. Tikhonov
Russian Federation

1. ABSTRACT

Persistent organic pollutants (POPs) are related to highly toxic chemical substances that negatively influence people's health and the environment. The twelve POPs included in the Stockholm Convention, including polychlorbiphenyls (PCB), hexachlorobenzene, toxaphene and DDT, were manufactured by enterprises of the Russian Federation up to 1993. These enterprises have since closed.

The Russian Federation signed the Stockholm Convention on POPs on 22 May, 2002 (The Resolution of the Government of the Russian Federation №320 from 18 May, 2002) and now is carrying out the preparation of its ratification. The problem of destruction/neutralization of POPs, such as polychlorinated biphenyls, hexachlorobenzene, DDT, toxaphene, polychlorpinene, and polychlorcaphene, in the Russian Federation has not been solved yet.

Methods and technologies for POPs neutralization existing in the Russian Federation by analogy to global practice can be divided into three variants:

1. Ground disposal of PCB-containing waste with observance of effective standards, safety rules, and actions on preservation of the environment
2. Chemical treatment of POPs with reception of nontoxic substances
3. Destruction of POPs

On the territory of the Russian Federation, there are four operating-waste polygons for ground disposal of POPs used in Tomsky, Leningradsky, Kaluzhsky and Omsky regions. There are four accredited Russian laboratories using international methodology and standards for POPs sample analyses.

International practice uses a processing rule where only liquid POPs wastes containing less than one percent by mass of PCB undergo chemical treatment. However, in practice, the Russian Federation is processing liquid wastes containing about 90 percent by mass of PCB. That's why after chemical treatment, the Russian Federation is obtaining dangerous wastes that need further processing.

Solving the need for POPs destruction is complicated by the fact that unfitted pesticides and polychlorinated biphenyls need to be processed by special ecologically friendly technologies. The foreign experience of POPs destruction demonstrates that the main technology is high-temperature oxidation using reactors with different constructions, such as:

- rotational furnaces;
- stationary furnaces;
- liquid waste injection systems; and
- plasma chemical technology.

There are some methods of POPs and other chlorine-containing waste destruction in Russia. Now it is accepted to combine destruction of "liquid unsuitable pesticides" and polychlorinated biphenyls as technological parameters and hardware registration coincide. Installations for the destruction of solid and paste-like POPs are similar with installation for the destruction of liquid POPs with some modernization by adding of the special mixing equipment.

The most perspective methods of high temperature oxidation include:

- High-temperature furnaces with a cyclonic reactor
- Combustion chambers of high-temperature rocket engines
- Installations on the basis of liquid rocket engines
- Installations on the basis of plasma chemical technologies
- Destruction in a stream of the heated gases
- Explosion of the explosive containing chemically neutralized PCB
- Fuel combustion at high-temperatures and contact heating
- Blast-furnaces
- Cement kilns

. On the basis of the considered technical, ecological, and economic requirements to technologies of POPs destruction, four Russian technologies of high-temperature oxidation were developed:

1. The cyclonic reactor for thermodestruction
2. The rocket engine
3. The liquid rocket engine
4. The plasmatron and a chemical reactor

Currently available neutralization technologies are divided on two basic groups. The first group, which is the most numerous, includes technologies that wash PCBs using the subsequent liquidation of transformers and containers. The second group, which is much smaller, includes technologies that wash PCBs from the internal part of transformers and then subsequently fills them with an alternative liquid.

Three existing Russian washing technologies for transformers and containers containing PCBs has shown that all of them belong to the first group mentioned above. Washing PCBs using vapors of chloride methylene is recommended by JSC “PetrochimTechnologiya” together with RNC “Prikladnaya Chimiya” after check in skilled scale. Washing of PCBs using toluene is presented by enterprise "GITOS" after experimental test. Washing PCBs using water-washing solutions is recommended by Novo Lipetsk’s metallurgical combine after an experimental test

All Russian washing technologies are stipulated cleaning of PCB transformers only “in gathering” with their subsequent disassembly and utilizing of metal details. According to technical, ecological and economic characteristics of washing methods from PCB transformers and containers in Russia, it is recommended that the technology use chloride methylene vapors as solvent. Mobile variants of such installations with above mentioned technology is also capable in certain circumstances.

Comparison of destruction methods of PCB containing condensers and international industrial practice of neutralization processes of PCB-containing condensers are carried out according with two dimensions:

- destruction of condensers; and
- neutralization of condensers with the subsequent recycling of metals.

Destruction is an investigated and widespread direction of liquidation of PCB-containing condensers. Some companies apply high-temperature burning of PCB-containing condensers, which have been preliminary crushed. Neutralization of condensers with the subsequent recycling of metals provides washing condensers, their disassembly, and the second washing of cases and cores.

Technologies of neutralization of condensers existing in Russia are also divided into two dimensions. The first dimension uses the following methods of burning:

- explosion of the explosive containing chemically neutralized PCB in particles of crushed condensers;

- fuel in high-temperature powder like mixes of filtration burning (PMFB); and
- bubble melting furnace with systems of fuel depletion and neutralization of tail gases.

The second dimension mostly uses the method of roasting of condensers. According to technical, ecological and economic parameters, bubble-melting furnace technology with systems of fuel depletion and neutralizations of tail gases is recommended for using in the Russian Federation. The high-temperature cyclonic reactor technology of POPs destruction is also recommended for use in Russia by a company called Synthesis located in Moscow.

Conclusions:

1. The period from the beginning of the development of new technology and installation for POPs destruction proceeds for a long time.

2. The development of new technology and installation for POPs destruction demand sufficient financial government and private investment support.

3. According to Federal Act of the Russian Parliament "About the Environmental Expertise" (1995) every new technology influence on environmental require conclusion of the Federal (regional) Environmental Expertise.

4. The number of the existing and operating technologies on POPs destruction in the Russian Federation with the positive conclusions of the Federal (regional) Environmental Expertise is imperceptible.

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OTHER TOPICS

SNOWMAN, A NEW INITIATIVE FOR TRANS-NATIONAL RESEARCH FUNDING AND CO-OPERATION

Nadine Dueso/Johan van Veen
France/The Netherlands

1. ABSTRACT

The overall objective of the ERA-NET SNOWMAN is to enhance the quality, relevance, and use of resources in Europe regarding research in the field of sustainable management of soil and groundwater under the pressure of soil pollution and soil contamination. SNOWMAN is a network of seven European research funders and administrations.

The SNOWMAN project wants to answer the following questions:

- What do we HAVE? Which research programmes are on stage?
  - "A SNOWMAN's Navigator through Research Funding Programmes across Europe. 2006" can be found at http://snowman-era.net/downloads/Navigator.pdf.
- What do we WANT? Which vision of a common ground can we set up? What hinders co-operation?
  - "Working Together In Research and Development for Sustainable Land Management in Europe—The Vision of SNOWMAN. 2006" can be found at http://snowman-era.net/downloads/SNOWMAN_Vision_Paper.pdf.
- How can we get co-operation now? What are the contents for coordinated research? Which mechanisms for co-operation are available and feasible at the moment?
  - SNOWMAN launched a coordinated call for research on December the 1st, 2006. Participants had to build trans-national research consortia involving at least two independent legal entities from at least two of the SNOWMAN countries. A step-by-step process was necessary to get settled and agreed funding rules before announcing the call.

Further SNOWMAN objectives are now:

- To achieve the implementation of this first co-ordinated research call.
- To disseminate the results of the funded projects amongst the participating countries and more widely.
- To disseminate lessons learned from the SNOWMAN Call.
- To establish a future research programme, with settled and agreed research funding rules and a well developed dissemination strategy.
- To tend to an enlargement of the group of national research funding organizations. Any interested organization is welcome!

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NATIONAL INVENTORY OF POTENTIAL SOURCES OF SOIL CONTAMINATION IN CYPRUS— PART 1: COMPILATION OF THE INVENTORY OF SOIL POLLUTING ACTIVITIES

Alecos Demetriades, Nikos Androulakakis, Maria Kaminari, and Katerina Vergou
Greece

1. ABSTRACT

The Hellenic Institute of Geology and Mineral Exploration (IGME), in collaboration with the Polish Institute for Ecology of Industrial Areas (IETU) and the Cypriot company, GeoInvest Ltd., were contracted by the Cyprus Geological Survey Department (GSD) for the provision of consulting services and technical support to the Government of Cyprus for the project entitled "National Inventory of Potential Sources of Soil Contamination in Cyprus." The objectives of the study were "to compile a National Inventory of contaminated sites, including all potential sources of soil contamination, thus setting up the framework of a Contaminated Soil Management and Remediation Scheme."

The Inventory is a valuable decision-making tool, not only for the assessment and management of potentially contaminated sites, but also for planning purposes to locate sensitive land uses near hazardous sites. Since, it is the first geographical-based Inventory to be developed in Cyprus with the aim to include all potential contaminating activities, it becomes an indispensable tool for the Government of Cyprus with respect to the European Union's Water Directive 2000/60, and also the pending Soil Directive, because it can identify pressures in each drainage basin, and categorise them according to their potential hazard on the environment.

The Inventory has been developed as a personal Access geodatabase in ESRI's ArcGIS software, the same platform used by Eratosthenis, the database of the Cyprus Geological Survey Department. The potential soil-polluting activities were categorised according to type and volume of hazardous wastes produced, and the probable organic and inorganic contaminants identified.

A very significant aspect of database development is the quality and integrity of data and information to be entered in the Inventory. Since, the Inventory will become an important decision-making tool, it must include high-quality information and legally defensible chemical and geochemical analytical results. Therefore, all information entered should be checked for its validity, and chemical analytical data for any sample type (e.g., soil and waste) submitted by companies should be accompanied by a validation certificate on the quality of the data. Geochemical data generated by the Cyprus Geological Survey Department also should be validated with quality control/quality assurance data. Dubious information and chemical and geochemical analytical data, if stored in the Inventory just for general information purposes, should be rated as of low quality and should be accompanied by a relevant document describing the data set (metadata).

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NATIONAL INVENTORY OF POTENTIAL SOURCES OF SOIL CONTAMINATION IN CYPRUS—PART 2: RISK-BASED APPROACH TO ASSESSMENT OF CYPRIOT CONTAMINATED SITES

Eleonora Wcislo and Marek Korcz
Poland

1. ABSTRACT

A risk-based approach to assessment of Cypriot-contaminated sites was developed under the project, "National Inventory of Potential Sources of Soil Contamination in Cyprus," as a tool to support remediation decisions at contaminated sites by the Government of Cyprus. The risk-based approach refers to human health, and may take into consideration both current and future land-use patterns.

The approach was designed as a two-step process: (1) preliminary assessment, and (2) site-specific assessment. For purposes of the preliminary site assessment, risk-based soil guideline values (RBSGVs) were estimated for 102 soil contaminants for Cypriot environmental conditions under three land use patterns – industrial, residential, and recreational. In step two, the site-specific assessment, when the developed Cypriot RBSGVs are exceeded, the use of a simple site-specific human health risk assessment (HRA) procedure is recommended. The two-step contaminated site assessment process has strictly defined rules of applicability, and may be viewed as an essential element of contaminated site investigation / assessment / remediation strategy.

For assessment consistency, the same HRA methods were used for the derivation of both the Cypriot RBSGVs and the site-specific HRA outputs. The applied HRA methods were generally adopted from recent US EPA documents. The developed RBSGVs are to be used as screening values, which would direct the follow-up investigation and risk assessment to aspects that require more attention. RBSGVs provide a general and conservative level of protection to human receptors under the defined land use. The site-specific human health risk assessment (HRA) process comprises two main areas: (1) baseline human health risk assessment (BHRA), and (2) development of site-specific risk-based remedial levels (RBRLs).

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MAPPING OF GEOCHEMICAL CONTAMINATION IN URBAN AREAS OF LITHUANIA

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1. ABSTRACT

In Lithuania, geochemical mapping of urban areas was started in Vilnius city in 1985. Topsoil, stream sediments, snow cover, manufactory dust, and other sampling media are used in eco-geochemical investigations. The aim of investigations is to detect sources of contamination, their geochemical properties, as well as the level and spread of contamination. The sampling grid in urban areas usually is irregular with regard to supposed anthropogenic load. The least disturbed residential areas are mapped at grid 250x250 m or 100x100 m, depending on population density and distance from industrial areas. The sampling sites are selected in such way that the amount of the soil samples according to types based on anthropogenic load or land use units (e.g., parkland, area of cottages, areas of apartment houses, and old town) would be statistically reliable (i.e., 100±10). The industrial areas (territories of enterprises) are mapped at grid 25x25 m or 10x10 m depending on soil sealing and diversity of industrial activities. The stream sediments, sediments of lakes and ponds, as well as sediments of dug wells are also investigated during urban soil mapping to estimate the pathway of contamination and its impact on groundwater quality. The latter one is the only drinking water source in Lithuania. Geochemical matrix of manufactory dust from vents and filters is used to detect the individual "geochemical fingerprints" of different enterprises and its contaminated areas. Snow dust (filtered residual) also is used to detect the area of industrial-emissions air transported and on deposited soil.

At present, the geochemical data on soil contamination in the areas of Vilnius, Panevėžys, Mažeikiai, Šiauliai, Alytus, Biržai, Pasvalys, Rokiškis, Kupiškis and other towns are stored by the geochemists of Geological Survey of Lithuania and Institute of Geology and Geography. In the soil of most cities, increased concentrations up to some tens (in some enterprises, up to some thousands) of most elements occur. Mainly contamination is related to local industrial activity. For example, at some enterprises the concentration of Zn, Cu, Ag, Pb and Cr in soil exceeds more than a thousand times and dozens, hundreds for other elements. Especially high concentrations of specific elements, such as Sb, Mn and W, was observed on territories of former enterprises that produced, for example, battery cells, agriculture machines, and drills In the contaminated cities, and especially in territories of enterprises, the associations of element-contaminants include non-ferrous and ferrous metals not characteristic for natural element associations These associations often reflect the specific features of contamination source and, in certain cases, could help to determine boundaries of its contamination area.

Sanitary assessment of urban soil is carried out on the basis of available geochemical data and the soil-quality standard of Lithuania HN 60:2004 and Hygiene Standard HN 97:2004. The objective of these standards is obligatory limit values of toxic substances (heavy metals, pesticides, hydrocarbons, PAH and PCB) for the soil (whole soil layer from surface till soil parent material) of residential, recreational and agricultural areas. Furthermore, the level of soil contamination with heavy metals is assessed not only according to the highest allowable concentrations (HAC), but also according to peculiar indices: the risk index K_0 and the total contamination index Z_s, which are related to the criteria of human health. According to the level of contamination, different actions in contaminated areas are required.

The soil geochemical background values obtained by geochemical mapping of natural areas and suburb land are always used for assessment of contaminated urban areas. Part of geochemical background and contamination data is published in the "Geochemical Atlas of Lithuania." Some geochemical data and soil contamination maps are used by town municipalities to determine which geochemical investigations of urban areas were performed in their jurisdiction. However, geochemical investigations lag behind the

planning, development, and reclamation projects of urban areas. Thus, new dwelling houses are often built on hazardous sites with “historical contamination” that may make a threat against human health.

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INVENTORY OF POTENTIAL CONTAMINATED SITES IN UPPER SILESIA REGION

Janusz Krupanek
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1. ABSTRACT

The proposed European Commission Soil Framework Directive requires taking up policy actions in the member countries. In the case of Poland, a contaminated land management system on a national and regional level should be carefully planned and implemented. One of the important regions of concern is the Upper Silesia, which is characterized by long-standing environmental impacts caused by industrial development. To provide an effective system of contaminated and post-industrial sites management in the region, strategic concepts and operational solutions are tested in carried-out pilot projects. The activities undertaken so far lead to preliminary identification of the potentially contaminated sites. The sites are of various natures. In the context of the new EU legislative framework, the most important are the post-industrial sites—especially heavy industry and mining facilities, operating installations, municipal and industrial landfills, and services like petrol stations. Various approaches for management of these sites are discussed. Assessment and prioritization is undertaken to select the sites for preliminary and detailed site investigation. Further steps of the contaminated land management procedure require application of efficient tools for verification of the initial hypotheses on the sites soil contamination and analytical and decision tools concerning selection of remediation options.

The presentation comprises the results of the carried-out pilot projects in the Upper Silesia region to inventory and assess the contaminated sites, procedural and methodological aspects of site characterization, and recommendations for contaminated land management strategy for Poland based on the regional study example.

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NORTH BOHEMIAN TERTIARY SEDIMENTARY BASINS AND NEGATIVE IMPACT OF BROWN COAL MINING ON THE ENVIRONMENT

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1. ABSTRACT

The mining of brown coal in North Bohemian Tertiary sedimentary basins, which is the basic source of electric energy in the country, represents with all its circumstances the highest negative impact on the environment of the Czech Republic. Together with the presence of other industrial activities in the region (e.g., brown-coal-burning power plants, local heating stations, chemical works, and extensive heavy traffic), open-cast mining is making the whole area the most environmentally affected territory within the s.c. "Black Triangle" in the Central Europe.

Now, the situation is much better because desulphurisation units were installed in all brown-coal-burning plants owned by CEZ a.s. (Czech Energy Ltd.), which subsequently definitively stopped the acid rain problems and switched the attention to other sources of air pollution.

The presentation briefly specifies the impacts of brown-coal, open-cast mining on different part of the environment. It also shows the projects dealing with the remediation and recultivation of land previously occupied by the large-scale, open-pit mining and recently used alternatively for environmentally friendly purposes and for the benefit of Regional Authorities.

Impact of Coal Mining on the Environment

The most damaged territories exist in North Bohemian Miocene brown-coal sedimentary basins, where past and recent underground and open-cast coal mining took place. These territories are located in the rift valley under the Krušné hory Mountains. The length of the basins is about 75 km and the width about 25 km.

The impact of existing brown-coal mining activities represents the largest destruction of geological environment in the Czech Republic. Some 260 km^2 of the land surface has been influenced by coal mining, of which 80 km^2 is covered by dumps. Many tens-of-square kilometres of landscape, including more than 70 villages and settlements, have been swallowed by advancing coal open-cast pits. This practically led to the total destruction of ecological stability and liquidation of traditional lifestyle in the whole area. At present, about 160 km^2 is used for mining activities in the North Bohemian brown-coal basins. Due to the continuous decline of coal mining, mining in this area will be limited to 85 km^2 in the year 2010. The high stripping ratio, which is in average 2,50-2,80 m^3/t, is characteristic of the North Bohemian brown-coal basin.

The circulation of the groundwater system has been disturbed and almost completely blocked. The expanding open-cast, brown-coal mines need large outer areas for dumping wastes. Large surface areas were affected by slumps. The original geographical relief is known only from the old maps from 18th and 19th centuries.

The most difficult and, until now, slowly solved problems by the remediation of the geological environment in North Bohemian basins are abandoned open-pit mines reaching up to 3,5 billions of m^3 in volume. A high content of sulphur reaching maximally up to ten percent and of arsenic up to two percent in the brown coal is a reason for several environmental problems, such as emissions and acidification. The continuous brown-coal mining could also influence the yield, hydraulic pressure, and CO_2 content of thermal springs of minerál water at the world-known Karlovy Vary Spa. The hydrogeological and static

conditions around the open-cast, brown coal mines are changing during their exploitation and have a negative impact on the foundation of buildings at the surrounding towns and villages. Many villages have already been destroyed and their residents have moved due to the progress of mining. Even now, the developers are trying to persuade the government to allow them to continue mining further to the northeast, which will damage another village.

In North Bohemian sedimentary brown-coal basins, 31,000 ha of land have been affected, 6,000 ha have been remediated up to now, and, on 3,100 ha, the process of remediation has just started. In North Bohemian brown-coal basins, there are 329 000 inhabitants. Until the year 2005, the mining production reached more then 90 million tons of brown coal mainly to support the electric plan needs. The electric power plants situated in this region are producing more then 60 percent of the electricity of the Czech Republic.

Environmental Remediation Program

As of 1989, the assessment of all integrated parts of environment pollution have been completed, and many evaluation projects and subsequent remediation programs have been designed. The situation has improved due to better balance between mining operations and dumping (prevailing inner dumps). There is no need anymore to build new outer dumps, and the older dumps are in a process of gradual reclamation and incorporation into the landscape.

Remaining pits (about 3 bil.m^3 are missing) are being flooded, thus forming lakes for recreation, though the problems with the duration of their filling, stability of their slopes and quality of their water are still not completely solved. Their slopes are being reforested. Large and costly landscaping projects are also in progress on outer dumps, where restoration of soil horizons is of great importance. In order to cut down expenditure on land reclamation, selective stripping of soil, such as topsoil, loess and loess loam suitable for recultivation, takes place when open-cast mining operations are shut down.

Forests, orchards, farmland, and even some vineyards have been established on plots of restored ground in a total area of about 66 km^2. Appropriate parts of some sites are prepared for various construction projects and some facilities (e.g., car-racing track, horse-racing track, golf course, and local airports) have been already sited on suitable areas. It is anticipated that shrinking of mining operations will accelerate the process of landscape reclamation.

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REMEDIATION OF CRETACEOUS SEDIMENTS AFFECTED BY URANIUM IN SITU LEACHING (ISL) IN THE CZECH REPUBLIC

Josef Tomas
Czech Republic

1. ABSTRACT

During the last 60 years, since the end of World War II, uranium mining and milling in the Czech Republic has caused an enormous devastation of the environment by means of waste-dumps accumulation, waste dumps left after uranium prospections, tailings impoundments, and other workings. All these negative impacts influenced the quality of the environment and affected mainly surface and ground waters and soils, and simultaneously polluted great areas of land and endangered the catchments of drinking water. The situation in this region is more critical because the area belongs to the protected natural water reservoir in North Bohemian Cretaceous Platform.

The Stráž pod Ralskem mining district, which was chosen as the most heavily polluted locality geologically, represents a stratiform-sandstone-type of deposit where acid *in situ* leaching (ISL) has been applied as the mining method since 1968. A quantity of 3.8 million tons of H_2SO_4, 270,000 tons of HNO_3, and 103,000 tons of NH_4 have been injected into the leaching fields of the Stráž deposit in the last 35 years, which has affected about 188 mil.m^3 of Cenomanian water over an area of 28 km^2. To solve the negative influence of coexistence of Hamr mine and ISL Stráž mine, a protective hydraulic barrier has been built between these two deposits.

To suppress the negative impact of an ISL, a desalination plant (evaporisation station) with a capacity of 5 m^3/ min. has been built and started to operate in 1996. The positive results were as follows:

- Polluted underground waters were stabilized.
- The water level in Cenomanian aquifer went down.
- The overlaying Turonian aquifer was not affected by Cenomanian polluted liquers.

The presentation describes the contemporaneous stage of the governmental remediation and recultivation programme.

HISTORICAL REVIEW

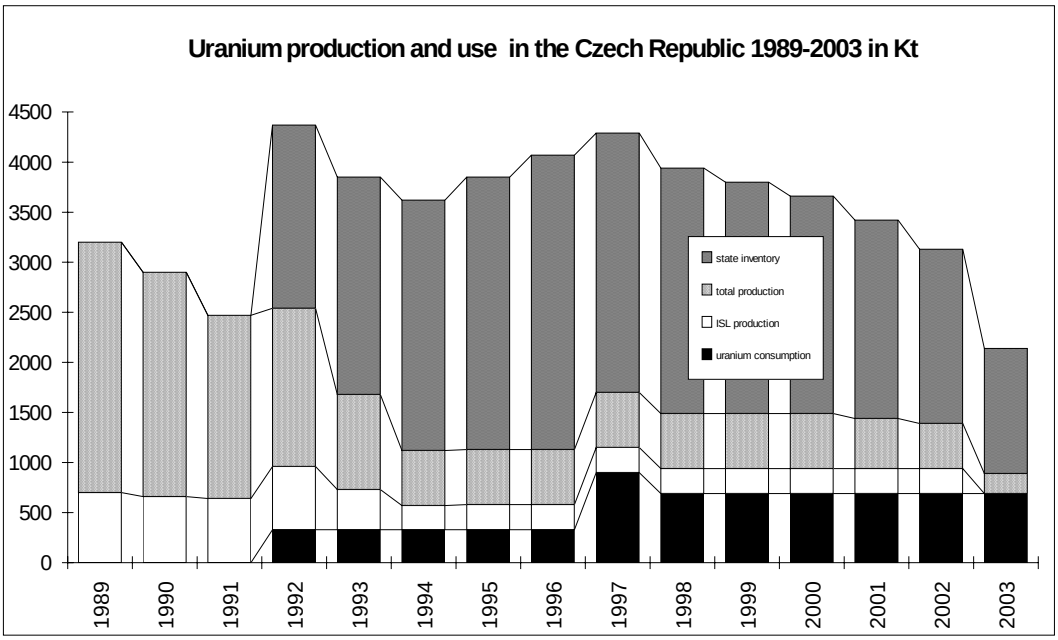
The Bohemian Massif belongs to a very important uranium-bearing province. Uranium mineralisation has been connected with post-variscan hydrothermal activity and emplacement of carbonatic dikes with uranium mineralisation. Uranium ores have been mined in Jáchymov (Joachimsthal) since 1840—first for making paints and later, when radium and polonium were discovered by Mme Curie, for producing radium. During the years 1907-1939, a total of 2.5 – 5.5 g of radium per year were produced at Jáchymov. The years 1945-1960 started the period of exploitation of uranium ores for army purposes. The first Soviet atom bomb was manufactured from uranium ore from Jáchymov.

After World War II, uranium exploration grew rapidly as a large-scale program in support of the Czechoslovak uranium-production industry. A systematic exploration program, including geological, geophysical and geochemical surveys and related researches, was carried out to assess the uranium potential of the entire country. Subsequently there have been opened and exploited following uranium districts:

- West Bohemian District
- Príbram and Central Bohemian District
- Rozínka District
- North Bohemian Uranium District

URANIUM MINES IN THE CZECH REPUBLIC

The majority of uranium deposits in Bohemian Massif are of vein type, but this lecture will pay an attention to the stratiform sandstone-type deposit, which is situated in North Bohemian Cretaceous Sedimentary Basin.



It is the newest uranium-producing district in the Czech Republic and its exploitation started in 1973. Because of a relatively large deposit (about 200 000 tons), the U-production was meant to cover all the long term needs of nuclear power plant supply, including export to former COMECO countries.

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PILOT STUDY MISSION

NATO/CCMS Pilot Study: Prevention and Remediation Issues In Selected Industrial Sectors

PROPOSAL FOR NEW NATO/CCMS PILOT STUDY

1. BACKGROUND TO PROPOSED STUDY

The current NATO Pilot Study on technologies for clean up of contaminated land will be completed in 2002. There are several reasons to conclude the pilot study. The primary reason is that general information on technologies, processes, and methodologies for the cleanup of contaminated land and groundwater has been discussed and distributed by the pilot study in its meetings and annual reports. Thus, the goal of the pilot study has been accomplished. There is ongoing interest by participating countries and countries with developing contaminated land programs to continue a dialogue, to focus on specific industrial sectors, and to maintain technical contacts and information flow provided by the current "network" of pilot study participants. Thus, a new pilot study is proposed in order for this long-standing global network on contaminated land to continue.

2. PURPOSE AND OBJECTIVES: NEW PILOT STUDY - SECTORAL APPROACH

Much of the work of the past pilot study on contaminated land has drawn on case studies of technologies applied to a wide variety of industrial and land contamination settings. While useful for explaining the basis for the technology, its costs, and applicability, the information available is not focused on certain problems or site types at a variety of scales, contaminant concentrations, geological conditions, etc. Thus, the current pilot study is a "technologist's" view of characterization and remediation approaches.

Of more relevance to governments, industry, and the remediation services industry is interpretive information about the measurement and clean up of certain contaminants in specific industrial sectors in a variety of hydrogeological settings and levels of severity of risk. In addition, environmental protection has embraced more holistic concepts of preventing problems as a first priority. Thus, methods for preventing pollution (both by process changes and by land use and planning initiatives) coupled with remediation efforts, are a priority for new and existing industrial development and for newly industrializing countries. This "integrated" approach can positively affect land and groundwater contamination as well.

Thus, a new CCMS Pilot Study entitled "Prevention and Remediation Issues in Selected Industrial Sectors" is proposed. The purpose of the proposed pilot study would be to define and explore best practices for reducing the health and environmental impact on soil and groundwater from industrial sectors of interest (e.g., metals mining, organic chemical production, gasworks, and fertilizer manufacturing) as well as other unique site "types" (e.g., old landfills, privatization sites [i.e., facilities transitioning from former state ownership in certain categories], mega sites [i.e., large scale former industrial and mining facilities], and shoreline sediment sites). In reviewing case studies as well as experience from the current pilot study on contaminated land and other sources, the proposed pilot study may be able to assess or benchmark "what is easy to clean," "what is difficult to clean," and "what is impossible, at reasonable cost, to clean."

3. SCOPE OF WORK

The duration of the proposed pilot study is three (3) years. The study would commence by selecting industrial sectors. The pilot study meetings would be devoted to the techniques and technologies for

preventing and avoiding discharge to soil and groundwater as well as measurement and remediation for that industry sector or site type. Countries would nominate expert speakers on such topics as industrial operations; problem definition and risk assessment; measurement and monitoring strategies; and remediation approaches for both soil and ground water. These speakers could represent many stakeholders, including industry, government, technologists, and consultants. The pilot study would seek to engage industry and other private sector organizations at the transnational level in sharing and evaluating technical information. The unique contribution of the pilot study would be measured by its ability to synthesize information regarding best practices, successes and failures, and uncertainties for the sectors of interest.

A typical pilot study meeting would explore topics, such as:

- Industry overview and assessment including typical waste stream and contamination issues
- Risk assessment methodologies
- Preparedness and planning issues
- Site characterization and monitoring approaches
- Prevention and remediation strategies including technologies and methodologies
- Institutional, financial, and public participation aspects of prevention and remediation

In addition, countries would be given the opportunity to present a general update of prevention and remediation activities via a Tour de Table as well as to provide country-specific industrial sector information. A limited number of countries would be selected to provide these detailed updates at each meeting.

It is proposed that the industrial sector of interest would be matched to the special interests to the potential host country for the meeting. Thus, host countries would have primary responsibility for involving industrial sector representatives and, possibly, developing a field visit to the affected sector.

4. ESTIMATED DURATION

Pilot Study Meetings: September 2003 - September 2005
Completion of Final Report : Spring 2006

(N.B. Pilot Study extended to 5 years in 2005)

5. PRODUCTS

An industrial sector report would be developed after each meeting. These reports would include invited papers from the industrial sector assessments, as well as summary information on the monitoring and evaluation of risks and strategies for prevention and remediation. Country update reports also would be included.

6. NON-NATO PARTICIPATION: BALKANS, CENTRAL ASIA, AND OTHER DEVELOPING COUNTRIES

In 2001, NATO/CCMS identified key objectives that would assist developing countries. These objectives include:

1) Reducing the impact of military activities
2) Conducting regional studies including cross-border activities
3) Preventing conflicts in relation to scarcity of resources

4) Addressing emerging risks to the environment and society that could cause economic, cultural and political instability
5) Addressing non-traditional threats to security

The proposed pilot study on Prevention and Remediation Issues in Selected Industrial Sectors specifically addresses #4 and also covers aspects of #'s 1, 3, and 5. The proposed pilot study would target specific industrial sectors based upon interests of countries with newly industrializing and developing economies. The study would provide these countries with a base of technical information and with a network of experts from whom to obtain advice. This proposal offers the opportunity for current pilot countries to continue networking and information sharing, and also provides a focus for discussions driven by partner country needs.

7. REQUEST FOR PILOT STUDY ESTABLISHMENT

It is requested of the Committee on the Challenges of Modern Society that it approve the establishment of the Prevention and Remediation Issues in Selected Industrial Sectors Pilot Study.

Pilot Country:	United States
Lead Organization	U.S. Environmental Protection Agency
Co-partner Countries:	To be determined.
Proposed Sector/Schedule:	Sector: Metals/Mining Sector
Date:	September, 2003
Host Country:	Romania
Location:	Baia Mare, Romania

7/02