

Přirozená atenuace sedimentů

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Sedimenty

- specifické prostředí
- silně ovlivněné antropogenní činností
- kontaminované sedimenty jsou velkým rizikem pro ekosystém i člověka
- organické i anorganické znečištění, často směsný charakter
- výraznější interakce vyšších organismů

Metody nakládání

- *Dredging*
- *Capping* (geotextil)
- Přirozená atenuace
- Podporovaná přirozená atenuace (v režimu augmentace a stimulace)

Popis systému

Retenční kapacita

Biologická dostupnost

Typ horninového prostředí

Charakter kontaminace

Struktura molekuly

Přítomnost vody v prostředí

Rozdělení mezi kapalnou a pevnou fází

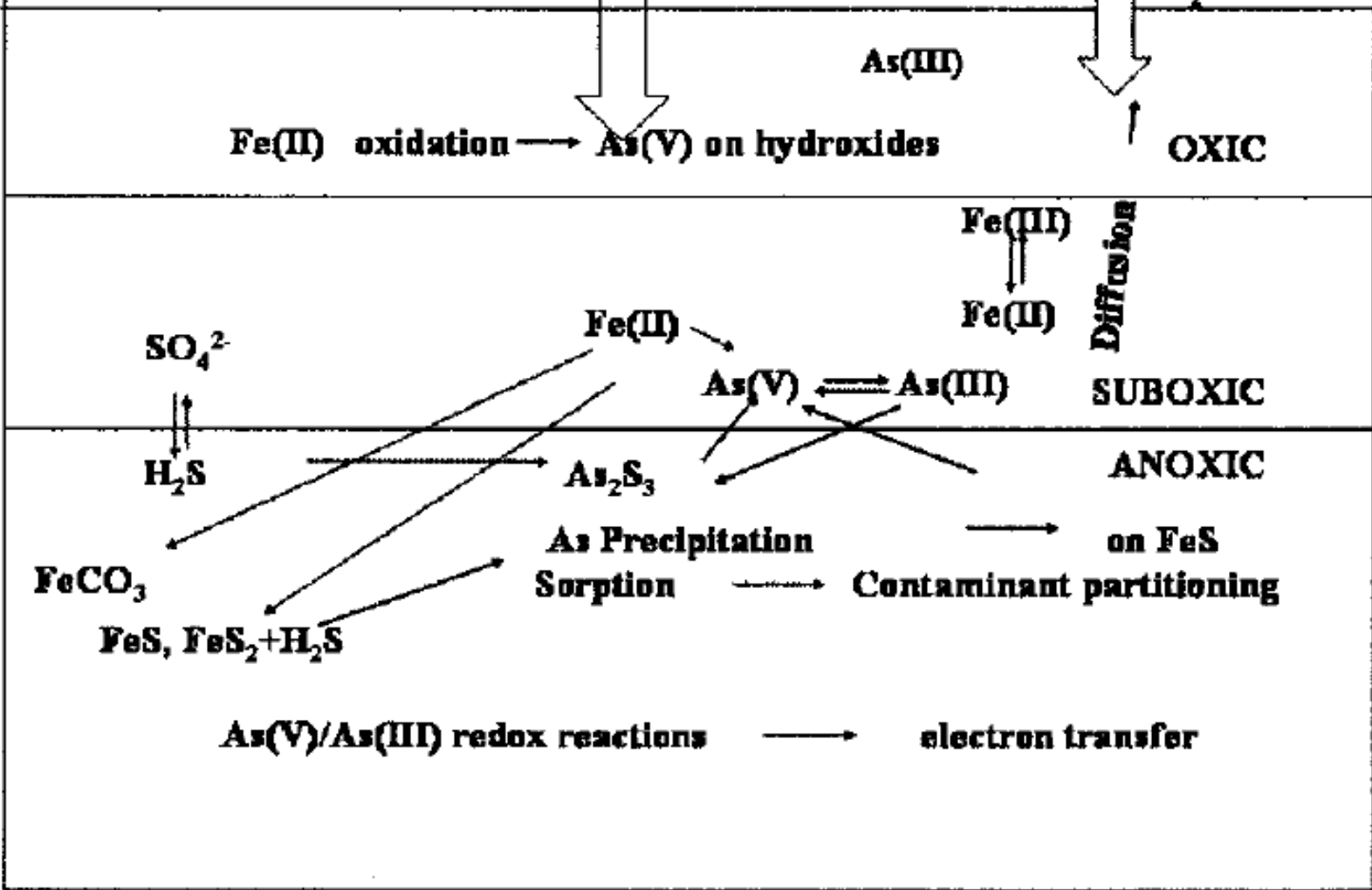
$$C_s = k_D \cdot C_w$$

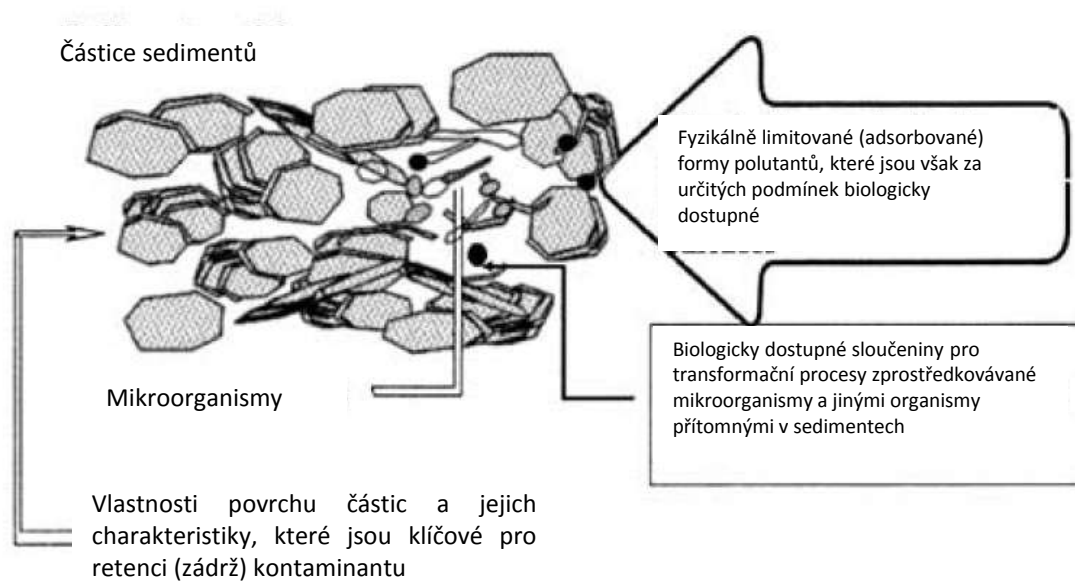
Vliv frakce organického uhlíku (k_{oc} , f_{oc})
Aproximace systémem oktanol – voda (k_{ow})

Fázové interakce

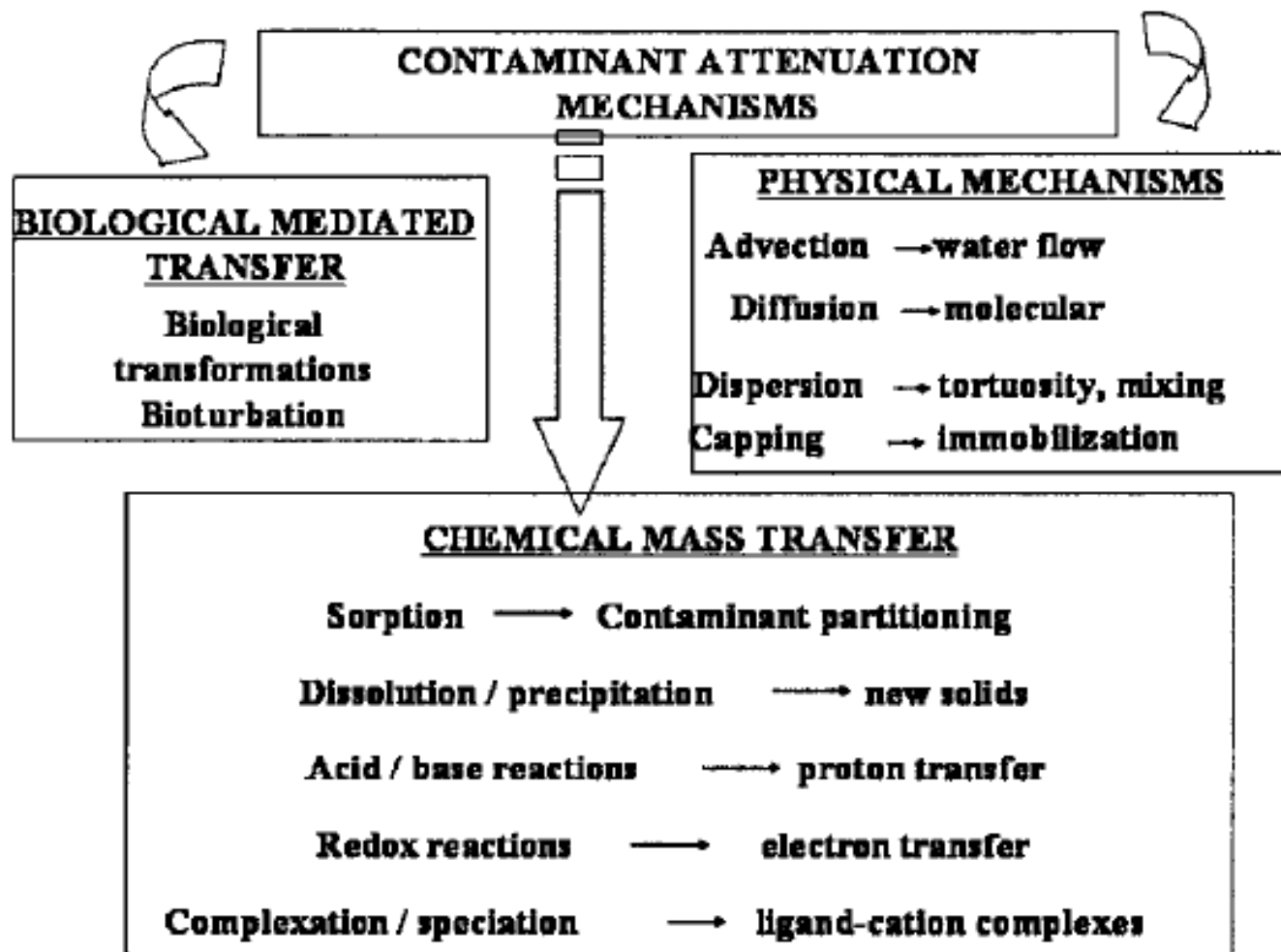
SEDIMENTATION OF AS(V)

SEDIMENT SURFACE





bioturbace



Protokoly přirozené atenuace pro sedimenty

Přirozená atenuace není technologií, nicméně ji lze považovat za nástroj technické ochrany životního prostředí (*remediation tool*). Pro vyhodnocení možností z přirozené atenuace sedimentů pramenící je třeba shromáždit markery pro uvedené tři linie důkazů. V případě sedimentů je zdůrazňováno:

snížování (snížení) koncentrace polutantu
podrobněji se jedná o geologické a hydrogeologické parametry, složení horninového prostředí a jeho asimilační kapacita a v neposlední řadě chemismus pórové vody

okruh biogeochemických indikátorů
analýza povahy polutantu na kontaminované matici, mikrokosmos, laboratorní testy rozdělovacích dějů a transformace, popř. modelování transportu a změn polutantu

důkazy mikrobiální aktivity
důkaz přirozené biodegradace, hydrogeochemické důkazy (akceptory elektronů)

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Overview of Natural Attenuation of Sediments

ABSTRACT: Natural attenuation involves the use of the natural processes with the soil and groundwater to remediate contamination by physical, chemical, and biological processes to reduce the risk to human health and the environment. Although the use of natural attenuation as a treatment process is increasing for remediation of contaminated groundwater, much less research has focused on contaminated soils and sediments. Industrial effluents, agricultural runoff, and sewage discharges are major sources of contaminants for the sediments. In addition, benthic organisms can transport contaminants through bioturbation, and there is considerable variability of sites. Organic materials, a particularly important component of the sediments, can sequester the contaminants. Sediment-water partitioning controls the release of the contaminants into pore water and benthic organisms. Fate and transport mechanisms for both organic and inorganic contaminants within the sediments need to be understood to establish protocols for the monitoring and use of natural attenuation.

KEYWORDS: natural attenuation, sediments, contaminant transport, protocols, mechanisms

Introduction

Approximately 0.9 billion m³ of sediment are contaminated which are a risk to fish, humans, and animals that eat the fish, according to the United States Environmental Protection Agency (USEPA) (1998). The contaminants that are left in the sediment environment without intervention can undergo naturally occurring processes. It is often more cost effective than dredging, capping, or treatment or combinations thereof, of the contaminated sediments and can be appropriate for low risk areas. Like natural attenuation of soil and groundwater, monitoring is a key element in determining the success and applicability of this remediation method. The natural processes include biological degradation, volatilization, dispersion, bioturbation, dilution, radioactive decay, sorption of the contaminants onto the organic matter and clay minerals in the sediments, and natural capping processes. These mechanisms will be discussed further later on.

Natural attenuation is mainly used for benzene, toluene, ethyl benzene, and xylene (BTEX) and more recently for chlorinated hydrocarbons. Other contaminants that could potentially be remediated by natural attenuation include pesticides, polychlorinated biphenyls (PCBs), and inorganic compounds (Yong and Mulligan 2004). The success of natural attenuation depends on the site conditions, sediment characteristics, and microbiology. In this paper, the mechanisms involved and case studies of natural attenuation of various pollutants at contaminated sediment sites will be examined.

Natural Attenuation Processes of Sediments

Abiotic Processes

Natural capping is one of the dominant mechanisms in sediments. This involves the covering of the contaminated sediments with clean sediments (Cardenas and Lick 1996), thus forming a barrier between the contaminated sediments and the aquatic environment. Sediment deposit rates will thus determine the rate of attenuation in this case.

Absorption reactions or processes involving organic chemicals and soil fractions are governed by: (a)

Parameters in Technical Protocols for MNA as Remediation Tool



Markers and Lines of Evidence

Loss of contaminant

- Geological and hydrogeological settings**
- Soil composition and assimilative capacity**
- Pore water chemistry**

Biogeochemical indicators

- Analysis of nature of pollutants in contaminated site**
- Microcosm studies**
- Laboratory tests on partitioning and attenuation**
- Transport and Fate modelling**

Microbiological evidence

- Evidence of prior occurrence of natural attenuation**
- Evidence from hydrogeochemistry**
- Evidence of natural bioremediation**

